The Feasibility of Autumn Based "Once Bred Heifer" Systems on Traditional Sheep and Beef Farms

A Study Using Linear Programming as a Modelling Tool

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Abstract

This study investigates whether it is feasible to incorporate an autumn based Once-bred heifer System (AOBH) into a conventional sheep and beef farm and by doing so make this farm more profitable. This is in response to what is appearing to be a consistent reduction in the New Zealand beef cow herd which is resulting in potential markets for prime beef unable to be filled. If the AOBH system is viable then it could go some way to meeting the need for extra prime animals to feed into New Zealand prime beef finishing systems.

The tool used to achieve this aim were a Linear Programme built up to include key aspects of a model sheep and beef farm and which was designed to show the mix for a livestock system, from those options provided. The "Default Farm" made up as was conceived to be a high producing East Coast farm with a ewe flock achieving up to 144% lambing, hoggets mated and lambed and all lamb progeny sold prime. The cattle on the farm are from a self replacing beef herd with progeny given the option through the programme to be sold or utilised in a number of ways i.e. sold as weaners, 10 months of age or as 20 months animals or in the case of the heifers in addition to the above also to join a spring based Once Bred Heifer herd (OBH) or a AOBH herd.

In the course of doing the research issues regarding how useful L.Ps are and what their usefulness to New Zealand farming systems was also considered and evaluated.

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Chapter 1
Introduction

1.1 Background.

When looking at livestock farming systems within New Zealand almost all models look first at matching the feed demands of livestock with the pasture supply curve. There are good reasons for this, the main being that this is the most biologically efficient way of farming and is what provides New Zealand farmers with their major competitive advantage over other primary product producing nations. This research is not trying to disregard this basic underpinning of the New Zealand pastoral system. What it is seeking to do is discover whether or not there are other systems which can be included on farms which do not follow the biological dictates but can contribute to and can in fact improve the overall profitability of a farming system by trying to fit market dictates without overly losing too many of the efficiencies gained by matching feed supply.

The market, represented in this case by the meat processing companies, does operate by and large countercyclical to the normal animal supply patterns. This is due to the desire, by processing companies, to fill the "shoulders" of the processing season . They do this by offering premiums to producers to supply animals in these "out of season" periods to improve the works' overall efficiency and throughput. While these premiums rarely outweigh the additional costs producers incur through supplying in these periods they do still shift the economics away from what would normally be considered the optimal time to breed and finish stock etc.

When looking for a system which may possibly fit into the above scenario, interest was revived in examing the "Once Bred Heifer" systems, in particular such a system based around autumn calving. If workable, such a system would be able to meet some of the additional demand for prime beef that New Zealand markets are currently seeking to fill with limited success.

For some time New Zealand has been experiencing positive returns from its prime beef markets over and above its more traditional "manufacturing" based markets. However there has been an increase in dairying, which has largely been at the expense of sheep and beef farms. This, combined with intensification of sheep and beef farms, has lead to the reduction in cow herds as the need for breeding cows to control surplus feed has reduced. The end result has been a steady reduction of the national beef breeding cow herd. Beef farmers have, instead of sourcing stock from breeding cows, gone to the dairy industry and sourced mostly bulls from dairy farmers and created finishing systems to maximise the bulls' growth and achieved good profits from this. The nature of bull beef means that most of the beef produced is unsuitable for the prime (table) market and instead is used in manufacturing (hamburgers etc).The profits generated from the bull beef systems have generally been higher than could be achieved from prime finishing systems especially when the cow providing the finishing stock is incorporated into the "cost" of the finishing system.

Currently with the increased profitability of prime systems, a shortage of animals suitable to go into the prime finishing systems is being experienced.

One way devised to help alleviate this situation is the "once-bred heifer" system (OBH). This system takes cull heifers from the dairy industry, often the result of cross breeding Friesian cows with beef bulls, mate these heifers at 15 months, calves them at two years and upon weaning the calf at approximately five months of age, get the dam into a condition where she is suitable to be slaughtered and be graded as prime. This system provides not only a prime heifer into the system but also her calf (at a later period).

Despite early farmer interest, this system has not achieved widespread popularity. The reasons for this are only speculative and anecdotal; in part from the writers own experience. Spring is a pressure point time on most farms and to incorporating another class of animal which has a high labour input, such as OBH's, just adds to this pressure. Most farmers find that looking after their replacement mob of first calvers is challenging enough. If the research found that there was evidence that spring OBH systems were potentially profitable then this could be a subject worthy of further investigation.

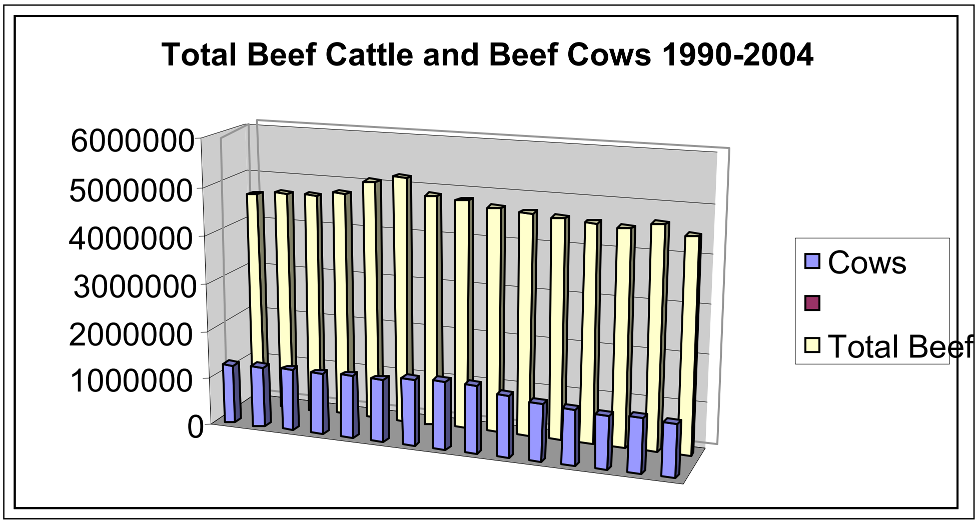
This project aims to relook at cattle systems to see if there are not other systems with potential to provide more prime animals to the export sector and at the same time improve current farm profitability.

Farming systems within New Zealand generally are based are the supply of feed. i.e. periods of high stock demand are matched to periods of high supply. These systems are set up to maximise feed use efficiency, profit it appears is assumed to be linked to this efficiency, i.e. the more efficient the more profit. This attitude has meant little work has been done to look at shifting farming systems around to improve profit possibly at the expense of efficiency.

This project aims to test a different system by shifting the OBH system from its normal spring orientation to an autumn based season. It further aims to utilise surplus heifers from the beef industry as the dam, rather than dairy sourced animals to provide the dams for the system.
A system such as the one outlined above was tried by the writer whilst managing a large North Island East Coast station. Unfortunately no recording of the various aspects making up the system was carried out. However it appeared to be working well and the intuitive feeling was that the system was profitable and did not operate at the expense of other systems. Through the use of Linear Programming (a computer modelling programme which selects the "optimal" solution) this project aims to replicate what happens on the farm and test the autumn based OBH system and see what effects it can have on both the financial and biological outcomes.

1.2 Industry Overview.

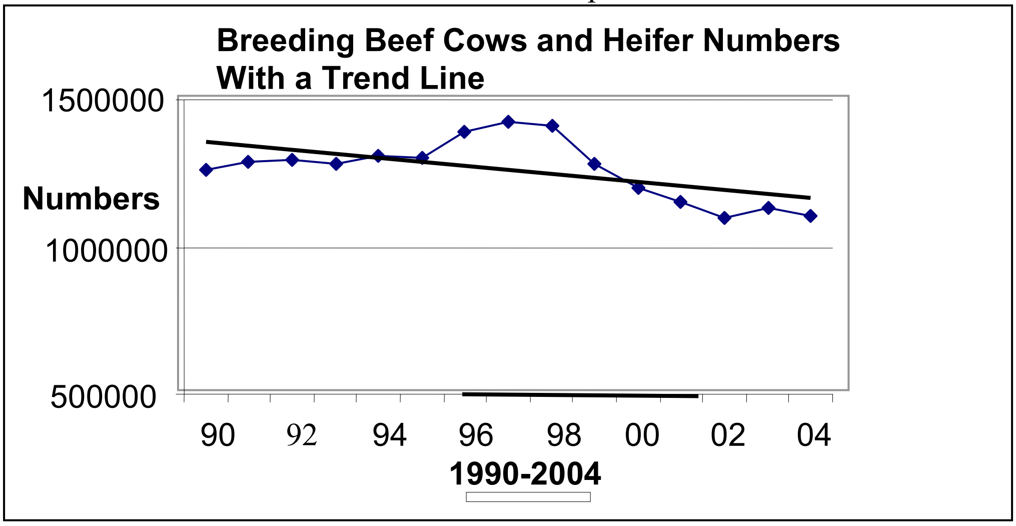
In recent years dairying has increasingly spread outside of its traditional regions into new areas such as Hawkes Bay and eastern and southern regions of the South Island. This has generally been at the expense of sheep and beef farms. In addition to this there has been a general erosion of beef breeding herds as farmers have found it more profitable to finish trading stock such as bull beef and steers. (See Graph 1)



Graph 1 (Sourced from MAF statistics)

Breeding cows are only making up 17%-18% of the total beef cattle herd; with the cow herd being approximately 800,000 even if all progeny are kept on farms until two years of age the total number of animals still only totals under 2.25 million animals. This is half of the total national beef herd. This indicates that many if not most "beef" cattle are in fact being sourced from the dairy industry. In addition to this, as Graph 2 shows, there has been a continual and it appears ongoing reduction in the size the beef cow herd.

Graph 2.



(Graph sourced from MAF statistics)

The reduction in the cow herd has made beef production systems more efficient given that *"In most beef cattle systems, researchers have established that 65%-85% of total feed intake is required by the breeding cow and that half of that total feed intake is required to just maintain the cow liveweight."*(Morris, 2003 p.1)

So systems that do not include the dam generally are more efficient than those that do. However there is still a place for the beef breeding cow, the challenge is that ways need to be found to make the system more efficient.

While this decrease in breeding cow numbers has been has been occurring there has been a shift in the economic balance between prime beef animals and manufacturing and also between sheep and cattle. This has been due to a range of factors which would have been difficult to predict a number of years ago. Sheep, particularly with through improved fertility which influences their profitability, have been the dominant livestock species on most farms and any beef system has to compete against them for their place within the farming system. Cows have been able to retain a place through their complementary position where they can assist in "grooming" pasture for sheep, reducing worm burdens for both sheep and cattle finishing systems and utilise feed unsuitable for other livestock.

Other "offshore" influences upon the prime beef trade include; trade restrictions placed upon USA sourced beef going into Asian markets due to the presence of "mad cow disease", Bovine Spongiform Encephalopathy (BSE), in the USA and Canada, ongoing issues with foot and mouth disease in South America, the longest drought in recorded history being experienced in Australia and lately the drive in the US to use corn to fuel ethanol plants. This last influence, a result of the Presidential dictate for America to provide at least 4% of its energy fuel as "bio-fuel" (USINFO.STATE.GOV 2007) has contributed; it appears, to a general lift in food commodities across the board. Corn is being used as the major bio-fuel source, despite a wish from Washington that other alternative "non-food and feed based products" be used. As a consequence production costs for feedlot and housed style animal production systems have lifted with the rise in corn prices.

The result of these changes has meant there is upward pressure on the price of prime beef. This has resulted in a shift in the "economic boundaries" between different types of beef finishing systems and the relative returns between sheep and beef systems, in favour of the prime beef finishing systems. However, New Zealand's ability to take advantage of these positive global factors is reduced due to the reduction in its beef cow herd size.

A way to quickly increase the potential number of breeding cows to provide prime stock is to adopt the OBH for surplus stock.

1.3 Research Aim

This research aims to investigate whether there is the opportunity to have an OBH system based on the autumn (AOBH) that is not only possible but actually may have some advantages over the more traditional spring based system, thereby making it more attractive to farmers to adopt. These advantages may be financial or biological or a mix of both. The research should also uncover if these advantages do not exist then what are the "trigger points" in both economics and biological efficiencies at which an AOBH system does become viable.

1.4 Key Questions

Questions that will be sought to be answered through the process of this research will be:

- Can AOBH be more profitable than conventional sheep and beef systems?
- How does AOBH affect feed supplies availability to the "whole farm system"?
- How does it affect the feed efficiency and what does that do to the biological systems within the farm?
- What are the potential impacts on labour supply\time?
- How is AOBH affected by feed supply patterns? i.e. Different regions or climatic influences.
- What is the potential of AOBH to help meet market demands for a source of more prime beef?
- How useful is the use of Linear Programming as a farm decision tool?

Chapter 2
Review of Literature

2.1 Introduction.

Literature which related to the issues surrounding the shortage of prime beef and opportunities in the current market place was generally only found in the "popular" press and in some cases was not credited to a specific author. This does not however mean that such issues do not exist or the articles were not credible. There were enough articles to indicate that the difficulty in the sourcing of prime beef animals to meet current market opportunities is a potential constraint in the system and that a look at alternative supply sources and systems is timely.

When looking for specific literature on autumn based OBH systems, nothing could be found and the best source of information was to research literature on spring based OBH systems, issues surrounding calving heifers as two year olds and autumn calving systems and extrapolate the information. The OBH research in particular was useful as it focused on issues such as carcass conformation and meat quality. Material was also studied relating to age and dentition issues in relation to market requirements.

2.2 Origins of the OBH system.

The earliest reference to OBH systems found was Tayler, (1975) who wrote a paper for the EEC on the feasibility of establishing a "Once bred heifer system" (OBH) in Europe. It was seen as a way to increase beef production without increasing milk production, but little was covered of the techniques involved.

Tayler believed it had potential as a way of increasing beef production without increasing the number of dairy cows and adding to the already large dairy surplus. It appeared, however, that there was a low uptake of the technology (Jarrige, R. and Berger, C.1992) due to the extra labour requirement believed necessary and the difficulties involved in calving heifers, especially when the heifer was committed to being slaughtered anyway. However, the comment was made that if there was a reduction in the number of calves able to be sourced for rearing and finishing (from existing herds) then the OBH system may be positively reviewed by many farmers.

2.3 New Zealand OBH Research

Research in New Zealand did not start until the late 1980's. S.T. Morris, of Massey University began trials to develop a system utilising surplus dairy bred heifers and evaluating the progeny of different sire breeds i.e. Hereford and Simmental. This work (Keeling, 1990) coincided with a paper presented by Nicol, A.(1990.) showing what potential there was for increasing production from the New Zealand beef herd and as a part of that incorporated the potential of OBH systems. Part of this recognised that a swing towards OBH would take animals away from the 160kg-200kg carcass range, which is used to supply the local trade market to a larger 270kg -300kg carcass suitable for export. At that stage Nicol identified a potential 100,000 heifers available for OBH systems. It appeared at the time that the main driver for going down the OBH path was a need to source more animals for the then "South Korean quarter-beef trade" (Khadem, et al. 1996)

2.4 Carcass Suitability.

A concern expressed by some researchers (Jarrige and Beranger 1992, and Morris 1990) is the risk of OBH being downgraded to manufacturing grade or cow which is worth considerably less on the beef schedule. The heifer schedule is currently advertised (Agridata April 2007) as $2.15-$2.26 a kg whereas manufacturing cow is $1.93-$2.18 a kg both for 195.5 kg to 220kg carcasses. (Agridata, April 2006). However Morris (1994) did work which compared the carcasses from OBH and unbred heifers and found while there were differences they did not affect the quality of the beef. In fact his work reinforced the opinion of Nicol (1990) that while OBH may reduce the supply of local trade animals it would be suitable for export due to the greater carcass weights able to be achieved through leanness of carcass (the animals that have been pregnant grow to a greater weight before "over fatness" becomes a problem). Where Morris did have some concerns was getting the heifers slaughtered before the eruption of their sixth adult tooth (1990) He felt that 36 months of age would be the top end of age to fit into heifer graded beef. However anecdotal evidence is that heifers are able to be graded heifer up to 42 months and beyond. This is evidence is reinforced by US Guidelines to farmers (fsis.usda) which says that normally 6 permanent teeth do not erupt until at least 42 months. A Queensland publication (Dodt and O'Rourke.1998) is more specific and has British breeds having 6 tooth eruption at an average of 38 months, with a spread of 32-42 months and Brahman cross cattle having an average of 41 months with a spread of 35-47 months.

Further work needs to be done to evaluate the impact dentition of heifers is having upon the grading of animals within the New Zealand context. Working with a meat works may provide this information. Farmer evidence is that teeth are not a problem prior to January, whether this is because works turn a blind eye due to the shortage of prime animals at that time of year or whether it is due to no more than six teeth erupting is open to speculation. However my experience was that teeth eruption up to the age of 40 months was not an issue as they were checked prior to trucking to slaughter. In fact later in the season I was often surprised when sending what was assumed to be "cow grade" animals to find they were classed as heifer.

Another area of concern is with the advent of BSE there may come a time when producers are required to certify their animals age, as some markets overseas require their local producers to certify whether they are under or over 30 months. If over, a 30%-50% discount may be imposed. The certification is required due to the very inaccurate nature of judging age by dentition (Peck, C. 2004). However, when Peck spoke to feed lotters in the USA very few admitted to practising much age discrimination and the "packers" said that their major loss was $8.00 per animal for the head over an over 30 month animal that was not processed. As little recent information addresses the topic it would appear to have become a non- issue, at least until the next major Bovine Spongiform Encephalitis (BSE) outbreak. A greater risk is the use of age as a non tariff trade restriction into some markets.

The major issue appears to be keeping spinal column and head parts out of the human food chain regardless of age. (Dow Jones Newswire 2006).

Although there is a definite correlation between age and tenderness (Purchas, and Burnham, 2003), within New Zealand there are no restrictions upon age of steers for slaughter yet there is for heifer, despite research (Khadem et al, 1996) showing that meat quality of heifers rearing calves is relatively unaffected. The main changes to the carcass are that it "hangs" slightly longer due, it is believed, to the ligaments becoming more elastic as a result of the calving process.

2.5 Breeding Timetable.

Bearing in mind the previous mentioned concerns, what this information does indicate is that there is a window of opportunity for practising AOBH systems. Because of the concerns over age there needs to be deliberation over when to mate for an AOBH system. Too early and stock may be affected by the dry period continuing from summer, too late and risk having stock downgraded due to teeth eruption. A calving date of late February is considered suitable as it is late enough so that as the calf's demands for feed increase it pasture supply should increase with the onset of autumn rains. This date should also be early enough to allow the heifer dam to fit into the age (dentition) range to allow the maximum return for the carcass to be achieved at slaughter. (Following table based on Lincoln tables Burtt, and Fleming, 2005).

Mating and Calving Timetable

Spring Based System	**Autumn Based System**
Mated November 22nd (15 month heifer)	Mated May 7th (21.5 month heifer)
Calve September 1st (2 year heifer)	Calve February 15th (2.4 year heifer)
Wean February 1st (5 month calf)	Wean July 15th (5 month calf)
Slaughter heifer May 1st (**32 month heifer)**	Slaughter heifer October 15th **(37month heifer)**

Table 2.1

There are certainly benefits in delayed mating of heifers when it comes to conception rate. At mating the spring based system heifers are 448 days of age which should be adequate to get all heifers in calf (Morris, 2001) but in reality many farmers who are mating heifers get very poor results of conception. Research by Byerley et al, (1987) found only 57% got in calf on their first pubertal oestrus whereas 78% were pregnant by their third. It was felt this was due to the greater age and extra weight. The delayed mating also enables later maturing exotic breeds and their crosses to have an improved chance of getting in calf (Morris, 2001) and improve the overall efficiency of the system.

2.6 Autumn Calving.

In the New Zealand context there is little information on autumn calving and what specific problems may arise from it. Internationally, and in Australia in particular, there has been some discussion (Beattie, W.A. 1954) looking at beef systems in the Northern Territory and more tropical areas which mainly revolve around matching feed supplies with animal demands. It does not have much direct relevance to the New Zealand context except in very broad terms. The local information that is available (Montgomery and Davis 1987) is a study on a "*Comparison of Spring and Autumn Calving for Beef Herds".* It was concluded that both spring and autumn had deficiencies, but that generally spring was a better match of feed supply to the animal's requirements and achieved higher calf growth rates. The autumn system achieved lower calf mortality and higher birth weights but a lower calf weight gain after birth. A drought, which affected the reconception rate of the Autumn Friesian cows and which was compounded by poor supplementary feeding over the winter affected subsequent calf and cow weight gains, stand out as a weakness of this trial. The trial only involved four seasons and in the drought year only three out of thirteen autumn calving Friesian cows got back into calf and this resulted in a skewing of the results. However in the other areas of performance the autumn system compared well with the spring apart from the previously mentioned calf weight gain. It was not published what this weight gain period was as if it extended for beyond 12 months it may have been reduced with the autumn calves getting the benefit of the higher M.E. of pasture in their first spring. The spring born calves would not be in a position to benefit from this. The issue of the cows not getting back into calf would also not present a problem for the Autumn OBH system with the cows (heifers) all being targeted to be slaughtered. Refer to table 2.2

Invermay Results: Comparison of Spring and Autumn Calving for Beef Herds.

Table 2.2

	Spring Angus	Spring Friesian	Autumn Angus	Autumn Friesian
Number of Records	151	50	54	57
Calf birth weights	29	38	33	41
Barren cows %	12	11	12	30
Calf mortality %	13	10	4	4
Calves weaned%	77	73	82	61
Calf growth rate (kg/d)	.84	.98	.66	.79

(Montgomery and Davis 1987)

The areas of weakness in the system were, by and large, related back to the fact that the trials were done at Invermay (Mosgiel lat 45s 51') which would not have had as good a fit of feed to demand as a milder North Island region. The lack of fit was shown in poor calf weight gains over winter due at least in part to a poor source of supplementary feeding (their sole feed supply). In discussion with some dairy farmers who practise autumn calving in Canterbury to supply the Fonterra winter milk contract, they do not find autumn calving for the calf an issue. Provided the calf is fed well and provided with some shelter they cope with Canterbury winters quite adequately. What the cost of being "fed well" is, remains a moot point.

Another interesting result is the extra birth weight of the autumn calves. Yet there is a reduction in their mortality which perhaps indicates more calf deaths are related to climatic reasons rather than size, especially for older cows.

An American study into autumn calving researched by Kastner et al, (2004), found that early autumn (fall) calving resulted in lighter calves. They surmised this was a result of "induced premature parturition" (page 3) due to the effect of heat upon the cow. They also surmised that this may result in reduced dystocia in first calving heifers. The shorter gestation calves ideally should have a similar weight to calves with longer gestation at a subsequent point in time provided they have adequate weight gains after birth, thereby not being inflicted with any economic penalty.

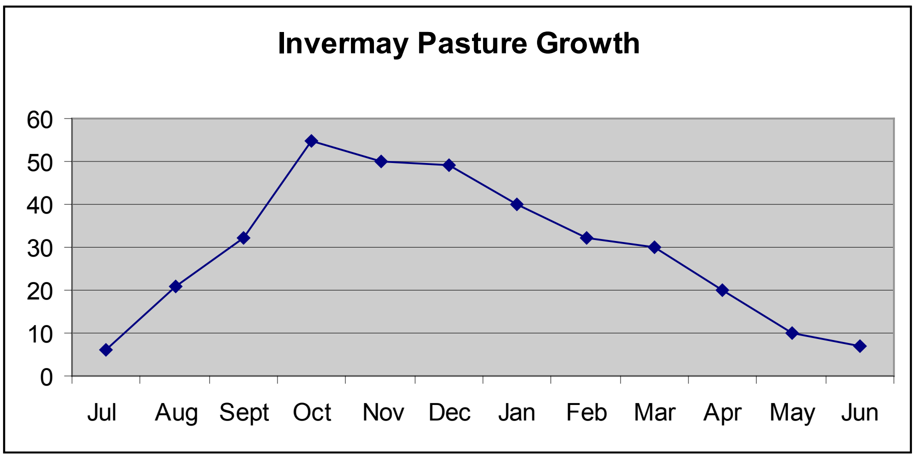
A note of caution may need to be added in that if the elevated ambient temperatures were the triggers then areas which have cooler summers may not experience the same results. This may be the reason Kastner et al results contradict those found at Invermay by Montgomery and Davis. Personal experience has that dystocia in first calvers in February was not an issue; this was in cows that generally had experienced very hot summers, certainly warmer than what could be expected in Mosgiel. Temperature records conducted in lowland Gisborne by Tangihanga Station for assessing the suitability of establishing vineyards within the station, in 1999 found that in December that year the temperature in the open exceeded 41degrees Celsius 12 times, (41 degrees was the highest the gauges could record to), with January and February being both considerably warmer than December.

2.7 Match to Pasture.

The incompatibility of the match between feed demand and grass growth could be seen as the major obstacle to calving in the autumn and the Invermay data highlights this. However, different areas of New Zealand have variations of this pattern which may mean that the mismatch of demand to growth is not as severe. That allows the possibility of successfully integrating autumn calving.

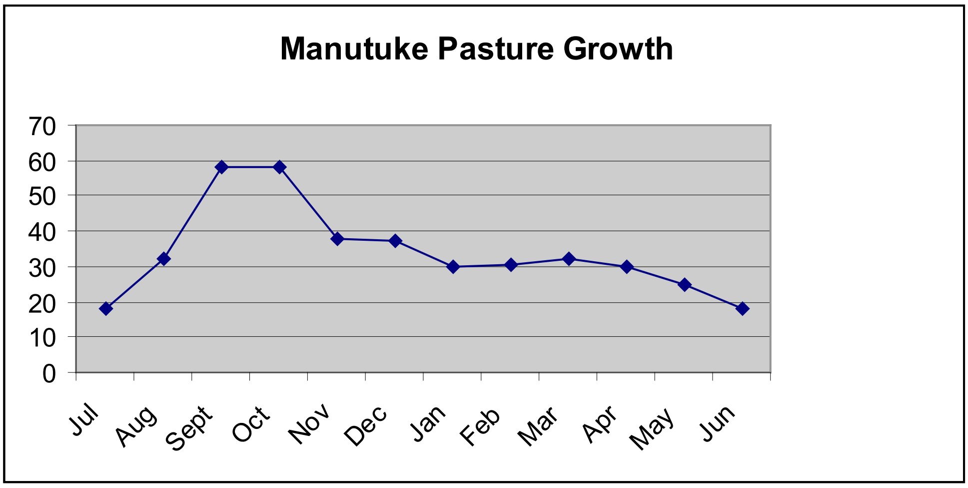
The tables below illustrate the differences that can be found within New Zealand.
Invermay grass growth pattern (New Zealand Sheep Council 1994)

Graph 3



Manutuke (Gisborne) Grass Growth Pattern (New Zealand Sheep Council 1994)

Graph 4



This then leads to the observation that in certain climatic regions there is potential to successfully calve in the autumn and this herd could be an OBH system. The difference in peak and minimum growth is 30kgs of DM per day in the Gisborne region compared to 53 kgs of DM a day in the Invermay model. The linkages between grass growth patterns and animal systems feed demand, and how they are adapted to create a farming system, are an important part of farm profitability (Webby 1993). This is an area where modelling with grass growth patterns and existing farming systems may be helpful in extracting the information to see whether OBH autumn systems can be made workable.

2.8 Sourcing and Suitability of Animals

The next question is "where to source the heifers?" Morris, (1994) felt that for a spring a based OBH system there was considerable potential to exploit the dairy industry as a source of animals. These in the main would be Friesian, or Friesian crossed with beef sires such as Hereford or Simmental. There is however a growing trend away from using straight Friesian cows in the dairy herd (Livestock improvement Centre, 2005) with a swing towards Jersey or Jersey cross animals. This swing is being driven by the suitability of the Jersey type animals to provide what Fonterra want (Van Beek, G. 2006). There is also growing interest in the "Once A Day" OAD milking system which is more suited to Jersey or Jersey cross animals (Dalley, D. and Clark, D. 2006). This swing away from Friesian animals in the Dairy herd is important as there is research to show that the Jersey and Jersey cross animals Barton et al (1994) and Burke et al (1998) are not as suited to beef production as Friesian animals. This is due to the lack of mature size which results in animals having a lower growth rate and smaller carcass. This leads to a lower Feed Conversion Rate (FCR) when compared to other breeds (Morris et al 2001) with Jerseys having a 25% lower growth rate than Friesians.

The more yellow colour of the fat found in Jersey cattle is also likely to lead to the carcass being downgraded to manufacturing grade. This is despite the Jersey meat being adjudged more tasty and tender by taste panels, (Charteris, P. and Garrick, D. 1997). Although the calf progeny are likely to posses only ¼ Jersey genetics, and may not be greatly penalised for having discoloured fat, their dams which are also going into the beef trade will, and they are a major source of the systems income. One favourable aspect is that while there has been a swing away from Friesian cattle, there has been an overall growth in the dairy herd meaning that there are more cattle to select from (Livestock improvement centre 2005 and Sonzaf 1999-2005) with 48.6% of 4.05m cows in 2005 being Friesian (1.97m) compared to 57% of 3.3m cows in 1999 being 1.9m, which reduces the impact of the swing.

There is also potential of sourcing heifers for the spring based OBH system from surplus beef bred heifers, as indicated by Nicol, but as only 30% of beef breeders are mating their replacement heifers (Morris, 2002), it is unlikely that many breeders will have heifers of a weight suitable for 15month mating of 270-300 kgs (Charteris, 2002) especially as the OBH animals are culls from the herd which has had the better animals retained as replacements. Bolze and Corah, (page 3 1993) state that as a rule *"a heifer must attain 65% of her body weight before showing signs of oestrus"* Earlier research (Carter and Cox, 1973) believed that 215kgs to 300kgs was all that was required to achieve a successful result however the later guidelines seems to reflect the difficulty farmers had at getting heifers back into calf when bred at the lower weights and more importantly for OBH systems the higher likelihood of calving problems and lower final heifer carcass weights.

For autumn calving systems there may be difficulty in sourcing suitable dairy cross animals. However, depending upon the uptake, there is a reasonable supply in the autumn of beef bred animals which could be suitable for the purpose (Wilson, 2006). The availability of any dairy heifers outside of the spring /early summer season is likely to be reduced due mainly to the structure of the current system in which dairy sourced calves are reared to 70-100kgs (approximately 100 days) and then purchased by finishers in November or December. For these animals to be used in an autumn OBH system would be at the expense of the system's efficiency with the animals having to be carried for an extra 6 months.

The most likely source of heifers to supply an autumn based OBH system is therefore likely to come from the beef industry with surplus heifers often being sold in the autumn as 18 month old cattle, which also improves the efficiency of the OBH system as they could be mated soon after purchase.

For this project it is envisaged that heifers are supplied from within the system from surplus "cull" heifers. These are animals that normally would have been taken through to 20-24months of age and grown to be suitable for the local trade market or sold as weaners for specialist finishers. Very few if any would have found their way into the beef herd to contribute to the supply of additional prime cattle.

2.9 Pelvic Development.

Research into the changes of physiology at the various changes in age of heifers has also been examined to ascertain whether age or size is a driver of pelvic diameter. This is important because if it is related to age as well as size, then this would explain the evidence that heifers have less calving problems in the autumn, as well as supporting the research of Montgomery and Davis, (1987) who also found that calving in the autumn led to a higher calving percentage. Pelvic area growth is assessed to grow at .27sq cms per day (Patterson et al 2005), while there is no evidence found to show that the growth is on a linear scale through to maturity, potentially, the autumn calving heifers have an extra 150 days of growth which may have enabled an extra 40.5sq cms of growth to occur.

Chapter 3
Methodology

3.1 Introduction

The aim of this research project is to explore the possibility that an AOBH system may have a place on New Zealand sheep and beef farms. Due to the limited number of farmers who are practising an autumn based OBH system (AOBH) a case study approach of studying the differences between a spring based only systems and those including a component of an autumn based OBH system was going to be difficult, if not impossible. Therefore it was felt that a quantitative research approach would have to be undertaken to provide the necessary data required to draw conclusions from. To this end it was decided that an "Operations Research" (OR) approach was the appropriate technique to follow. The best method to achieve this was through the creation of a linear programme (L.P.).

3.2 The Linear Programme.

Developed by George Dantzig and others through the 1940's and 50's it is a technique which uses a mathematical approach to solving management problems and arriving at the "optimal allocation of resources" (Gass, S.I. 2005). Microsoft Excel programmes include a "Solver" option which is a L.P. It was this programme that has been used as an aid to answering the research question

The L.P. has inputted a range of data which it accepts as options to select from. It decides which mix is optimal to fit in with the financial, biological and other constraints that may be applied to it. Care has to be taken when "building" the L.P. not to "force" it down any particular path that may distort or bias the outcomes. An existing computer generating "farm decision tool" "Farmax" programme was not used as it required the operator to select the mix of livestock and provided outputs relating to this mix. It did not analysis the "mix" to question if it was the optimal one with the given constraints. However Farmax was used to test the L.P. solution to see if it was feasible within the "Farmax" guidelines.

Farmax which is "underpinned by the Stockpol programme (developed by AgResearch Ltd) quantifies the various options put in it by the operator, i.e. the operator selects how many cattle and sheep are to be carried on the farm and what the mix of selling stock is to be. The L.P. selects what is the optimal mix. The Farmax programme has its own set of assumptions and biological inputs which should arrive at a similar financial outcome to the L.P. If not then further diagnostics would need to be done to find out way

A L.P. matrix was created which encapsulated the key aspects of a “whole farming system” which would best provide the details required to be able to compare the AOBH system to conventional spring systems. A “whole farming system” which included a wide range of economic and biological factors was created rather than just looking at the AOBH or spring systems, as issues relating to the ratios of sheep to cattle and the different livestock demands upon the feed supply would have been otherwise unable to have been captured.

The “farm model” which the L.P. aimed to replicate is situated on the North Island East Coast. This area was chosen due to familiarity of the researcher with the area (30 years of farming had been conducted in and around this region) and there are also a large number of beef herds in this region which may be able to obtain some benefit from the research results. Stock performance, weights and breeding dates have been used which reflect what is likely to occur in this area. The dates selected for the AOBH system also tried to best match the autumn feed supply. The calving percentages for the AOBH system were set at 90% whereas the first calving spring based systems are set at 80%. This is due to the more favourable weather conditions, older age of the dams and “heat effect” over gestation resulting in calves having a slightly lower birth weight. (Kastner et al 2004). These advantages are also reflected in a lower death rate of the AOBH herd. The cattle in the model come from a self sustaining breeding herd made up of Angus or Angus cross cattle and the sheep also from a self sustaining crossbred flock. There were no traded stock in either the cattle herd or sheep flock with the only brought in stock being bulls and rams for breeding. Calving and lambing percentages at 90% and 144% respectively for the mixed age stock are adjusted for age and season where it was considered necessary (see Table 3) and are good for the region.

Table 3.1

Stock Performance	
Cattle	
Calving percentage	
M.A. Cows	90%
Heifers	
Replacements	84%
Spring OBH	80%
AOBH	90%
Lambing Percentage	
M.A. ewes	144%
2ths	138%
Hoggets	85%

Good performance figures were selected as the “model” was hoped to emulate a well run farm with good livestock performance. The programme has the ability to set the “optimal result” with any ratio of sheep to cattle required, but for this project it was initially restricted to have a minimum of 40% cattle to reflect a likely scenario in the East Coast district (some farms have a 50-50 ratio so 40% cattle is not overly high). As all cattle systems selected to compete against each other and sheep had the same restrictions applying this constraint is not seen as having any effect on the outcomes except it prevented an all sheep or all cattle system being adopted. Like wise the lambing percentage selected should not have a marked influence on the cattle systems selected by the programme. To achieve the different ratios between sheep and cattle feed has been allocated to the various stock classes depending upon their demand. The total allocations, measured in mega joules of energy, (MJME) has then been divided by 6000 MJME with that rate being the estimated requirements of a traditional stock unit. Therefore most breeding cows were 5 and ewes were 1.3. The division of 60% and 40% was based around this formula. All stock were taken into account not just balance date figures thereby providing a truer representation of the allocation of feed between sheep and cattle.

The L.P. was built “visualising” an East Coast property but with the ability to change feed supply being relatively simply it could also be applied to other regions although some of the breeding and selling dates may not be as representative.

Due to the complexity of most sheep and beef farming systems, especially when an OBH system is included, the creation of a programme able to complete this task became in itself a major exercise. It was felt that it had to have the ability to sort through a range of livestock farming alternatives and come up with conclusions that would not only show which system was best but also whether there were mixes of both AOBH and spring systems that could work. The L.P. was given no option but to mate replacement hoggets, however it did have the option to include a “terminal sire” mob made up of 10% of the cull ewes from the main mob. This was done to provide more detail to the production factors that may be acting upon the sheep system.

The cattle herd also was not provided with the option of leaving heifers dry as 2year olds and mating to first calve as three year olds as, apart from issues of “best practise” (McMillan and McCall 1991), the programme was likely to have selected the mating as 15 months due to the financial advantages it provides. Finally a SpOBH system and AOBH system were included.

3.3 Feed Demand.

A comprehensive feed demand section was included which reflected the changes in live weight, live weight gain and maternal status i.e. from being dry to pregnant and rearing progeny. The basis of the formulas used to arrive at the various feed demands was obtained from “A Re-assessment of the Stock Unit System. A Report prepared for the New Zealand Ministry of Agriculture and Forestry” (Woodford and Nicol 2004). The whole area around feed requirements does appear to still be being debated and more work may need to be done. (Woodford and Nicol 2004). In the context of this study differences in the feed demand by sheep and cattle may result in slight differences being obtained in the sheep to cattle ratios but is unlikely to impact upon the AOBH comparison to SpOBH systems as both are using the same assumptions

3.4 Feed Supply.

The feed growth curve selected was selected from data from the Manutuke Research station situated 20 kilometres out of Gisborne. The data was provided in dry matter form (D.M.). Before being put into the programme it was converted to mega joules of metabolisable energy (MJME) with the rate being adjusted for the time of year. (See appendix) Guidelines from the Farmax model were used for MJME rates throughout the year although no specific allowances were made for the pasture height and age affect on pasture quality. However there was a cost applied to feed being carried over from one month to another to reflect a loss of quality. This as well as reflecting reality was to try and encourage the programme to utilise the feed in the month it was grown. The programme had the options of making, purchasing and feeding out hay or silage, but at a cost. The data was restricted to 85% utilisation of the total to better reflect inefficiencies by grazing animals being unable to harvest all that is grown. Several other regions grass growth supply data were also compared to be used as comparisons and to help highlight any issues relating to feed supply. These were Northland which has the lowest differential between winter and summer grass growth rates which it was felt may make it more suitable to a autumn based system and Canterbury both irrigated and non- irrigated to test the programme against a region with a high differential between winter and summer (in the case of the irrigated model) and a dry land model with cold winters.

3.5 Financial Inputs.

General running costs for a pastoral property were included; these were obtained from the MAF farm monitoring model (Hawkes Bay/Wairarapa Hill Country Sheep and Beef farm) and applied as a per hectare charge. The total size of the model farm was set at 600ha, a farm this size could reflect the system issues adequately and provide data outputs which farmers from a range of farm sizes could relate to. The per hectare charge was the same for all regions with the exception of the irrigated farms which had an additional charge for irrigation added.

Specific costs relating to each class of livestock were applied, thereby allocating costs to where they fell.

Income for each class of livestock was obtained from the AgriFax price monitoring service, with a five year average used. (2001-2006).

Lamb sales were made to be spread in a manner which best emulated what it was believed a “real” farm would follow and weights matched the time spent on the farm. The L.P, left to itself, would almost always sell all lambs at weaning as the increase values from higher weights would not outweigh the increase in costs. Older ewes were all sold as “aged” ewes in January, not ideal but adequate and simpler than trying to replicate the “real” situation when ewes are likely to be sold post scanning, post docking and after weaning.

Cattle sales were more restricted with male cattle restricted to being sold as weaners or R2yr in June. Female progeny could be sold as weaners, (six months of age) R1yr in June or, in the case of the OBH dams, three to four months after weaning. It was felt that as the AOBH were already five to 6 months older there was less time required to get these animals into a "prime" condition when compared to SpBOBH which were still maturing and also they had the benefit of having spring included in their "finishing" period. As a result the AOBH were sold four months after weaning. Aged cows were culled from the herd after weaning as ten year olds, again in the interests of simplicity.

Culling both the ewes and cows after they had weaned their final offspring did have an effect on the farms overall efficiency and was likely to have created some minor distortions to the feed demand requirements. However it was felt these distortions were not going to alter the final conclusions of the research.

Building a more comprehensive L.P. to incorporate all, or at least more, aspects of a sheep and beef farm would have made the conclusions reached more robust. But it is debatable whether the conclusions would have been any different and the time involved in completing such a task was beyond the scope of the dissertation research.

3.6 Analysing the Data.

The L.P. was set up provide the numbers of the various classes of livestock and the cash surplus (loss) provided by the system over a twelve month period. By "switching off" the AOBH option and rerunning the programme the outcomes of the two systems (with and without AOBH) could then be compared and depending upon the answers provided, conclusions could be drawn as why the results that occurred did and what lessons and inferences could be taken. The programme inputs could also be altered to see what the "tipping points" were to require the programme to change from one system or mix to another. This was seen as particularly useful when monitoring changes in the economic returns of various systems or classes of livestock.

Chapter 4
Results

4.1 Introduction

This chapter looks at what results can be extracted from the L.P. The major focus revolves around the "default" settings i.e. East Coast pasture tables with a 60% to 40% sheep to cattle ratio and with the AOBH option available. Having satisfied this area, the L.P. will then be adjusted to find tipping points (points at which the results have major system changes). This will be done relatively simply by altering returns derived from different livestock, ratios between sheep and cattle, altering the feed supply and costs. A "conventional model" i.e. a model without the option of including the AOBH system will also be run to act as a benchmark for other systems to be judged against.

These results will seek to provide information to answer the key questions of:

- Can AOBH be more profitable than conventional sheep and beef systems?
- How does AOBH affect feed supplies availability to the "whole farm system"?
- How does it affect the feed efficiency and what does that do to the biological systems within the farm?
- What are the potential impacts on labour supply\time?
- How is AOBH affected by feed supply patterns? i.e. Different regions or climatic influences.
- What is the potential of AOBH to help meet market demands for a source of more prime beef?
- How useful is the use of Linear Programming as a farm decision tool?

4.2 Default Farm Model Settings

4.2.1 Pasture Supply

The information used for the East Coast model pasture growth has been obtained from the Manutuke Research Farm. No longer operating, this research farm was operated by the Ministry of Agriculture from the 1960's through to the early 1980's and compiled over twenty years of pasture growth rates. An average of 11750 kgs dm per ha per year was obtained with a range from 9050kgs to 14450kgs per year for two out of three years (Farm Technical Manual Lincoln University). No nitrogen or irrigation was used in this particular model.

The normal method of gathering grass growth was from the "cage and cut" method.
This has found to be up to 30% higher than whole farm methods (Piggot 1997) so care needs to be taken when adopting these figures however as analysis is contained within the system not between other systems this is not seen as being a constraint to the research.

Recognising that not all pasture that is grown is utilised the amount of feed supplied to the L.P. was adjusted down by 15% so 9903kgs was provided into the system. This amount was further modified by converting into mega joules of metabolisable energy (MJME). This adjustment was done on a monthly basis and the conversion rates provided from the Hawkes Bay (Dryland) data in the Farmax Pro computer model used. MJME was selected as the denomination of measuring pasture as it could be better matched to animal demand than kilogram of dry matter which is going to change its quality (energy) levels through out the year and amounts consumed would need to be adjusted to take into account these changes.

To encourage the programme to use pasture close when it is grown, thereby making the "farm model" more efficient a 15% loss of pasture was applied to any pasture that was carried into the following month. This given, the programme still carried feed forward when it decided the economics dictated it. The maximum amount carried forward was 13,585MJME (1332kgsdm) from November to December with similar amounts being carried forward from December to January and January to February.

4.2.2 Supplements

The "farm model" has the option to convert surplus pasture into either hay or silage. The silage option was available in the months of September through and including April and incurred a financial cost at harvesting of .9 of a cent per MJME and an additional cost of .3 of a cent at feeding out. (A total of 13cents per kgdm). A reduction of 15% is applied to the amount fed out to replicate wastage in the making and feeding of silage. The model has the option of feeding out silage in the months of March through to September.

Hay was also able to be made in the months of January and February and able to be fed out in June, July and August. Hay incurred a higher cost with it being allocated 1.3cents per MJME to be made; no cost was allocated for feeding out. Hay could also be purchased at 1.7cents per MJME however the model chose to purchase no hay also. No supplements were made in this model also.

No provision was provided to apply nitrogen to grow extra pasture as a form of feed supplement; this is an area to be explored in the future.

4.2.3 Farm Efficiency

A measure was applied to the "farm model" to measure its efficiency at utilising pasture grown. This was done by assuming a standard stock unit consumes 6,000MJME per annum. It was with this assumption that livestock ratios were allocated between sheep and cattle. The total number of stock units carried per ha was then divided into the total amount of MJME supplied into the model. For the default system this came to 87.8%. This level is considered to be on the higher side of what an average East Coast farm would be achieving.

4.3 Financial Results

4.3.1 Farm and Animal Costs

Set costs of $410 per ha were applied to the model over all hectares that the model choose to use. Total set costs for the 600ha model farm are $246,000. Fertiliser and wages make up the largest of the set costs, $54,000 and $55,000 respectively. Additional costs were applied on an individual stock unit basis depending upon the class of animal involved. These costs included where applicable; interest, animal health, shearing, cartage, a death rate and breeding costs. These costs come to $138,452. This is more than most farm budgets would show as it incorporates the interest cost (at 10%) applied to livestock while they are on the farm. The interest cost is the largest of all the individual costs, it contributes $80 to the maintenance cost of a breeding cow which has a total cost of $125.40 (64%) and $8.50 to a breeding ewes cost of a total of $23.61 (36%). The approximate individual livestock costs as allocated have sheep having a slightly higher cost (5%) than cattle at $18.44 per S/U compared to cattle at $17.58 per S/U.

The total costs incurred by the "default farm model" are $384,912

Additional costs to the different livestock enterprises such as woolsheds, yards and fences etc were not factored in. If they were these would currently favour cattle.

4.3.2 Animal Returns

To get an accurate measure of what the various livestock enterprises were able to return data was obtained from AgriFax on a weekly basis, going back for the last six years. These results were then averaged out for each month and then allocated to the respective livestock sales in the months that the sales took place. These results were only applied to stock that was sent to slaughter. The returns for stock that was sold onto the "store" market (highlighted in red on the model) was obtained from a variety of different sources and lacks the "integrity" of the AgriFax data but was the best that could be found and is still believed to be representative of what sales are likely to be.

Wool returns and weights were also selected from three regions average performances over the last five years as published by MAF SONAF (2006). Central North Island, Gisborne Hill Country Sheep and Beef and Hawkes Bay Wairarapa Hill Country Sheep and Beef were used and the total of these results averaged to go into the model. The average price per kilogram of wool (greasy) was $2.72 with the weight allocated to the various ages of sheep coming out with a result slightly ahead of the 5.1kgs averaged from the MAF data.

Summary of Prices allocated to livestock (per head)

Table 4.1

Sheep Months	**December**	**January**	**March**	**June**
Lamb Sale	79.67	64.78	65.19	72.03
Cull ewe lambs			55.00	
Cull ewes		50.00		
Months	**March**	**April**	**June**	**October**
Cattle				
Cull Cows	558.32			
Heifer calves		350.00		
Male Calves		480.00		
1yr Hfrs			480.00	
1yr Males			550.00	

AOBH males 15months		785.61
Male R2 yr		918.77
Female R2yr		650.00
Spring OBH 2.5yr Hfrs	699.61	
AOBH 3yr Hfrs		950.10

The gross income achieved in the farm model at the default setting was $482,209 or $804 per hectare. Net returns pre tax and depreciation were $97,297 or $162 per hectare. The average net return (pre tax and depreciation) from the three MAF models used as comparisons was $152. Given that the MAF data did not use 2001 data which was a particularly good year and forecasted 2006/2007 to be a poor year financially these results appear to be close and make the farm model appear credible.

4.3.3 Livestock Numbers and Composition

While the farm model has a stocking rate of 14.64 when the stock that are not on the farm at the beginning of July balance date are removed this stocking rate is reduced to 12.89 per ha. The stock that are deducted, are works lambs that are still on the farm for part or all of the autumn. This will lift the balance of the stocking ratio slightly so cattle will be 41%. As earlier stated the 60%-40% sheep to cattle ratio was based on total feed consumed over a twelve month period.

Summary of Default Farm Model Stock on Balance Date

Table 4.1

Sheep	Ewe Hoggets	2th Ewes	M.A. Ewes	Rams			
	619	575	1,567	34			
Cattle	R1yr Hfrs	R1yr Males	R2yr Hfrs	R2yr Males	R3yr Hfrs	M.A. Cows	Breeding Bulls.
	175	175	137	0	80	256	6

It needs to be noted that among the cattle numbers in fig 1 are 80 autumn calving heifers and 72 calves.

These AOBH are the 80 R3yr which are sold in October and the 72 calves sold at 15 months of age in June are their progeny.

4.3.4 Default Farm Model Summary

Table 4. 2

Activity Level (Animal numbers)			
Total S/Us on an annual Basis			8,788
SUs per Ha on an annual Basis			14.65
SUs ME requirements			6,000
Feed Consumed (MJME/10.5 to convert)			87,878
Per hectare Supplied (MJME)			100,093
Total feed supplied Utilised			87.8%
Total farm Costs			-385,310
Gross income			481,782
Per ha			803
Net Farm Income			96,472
net per ha			161
Balance date S/U			7,733.59
S/Us per Ha			12.89

Tables 4.1 and 4.2 provide a summary of the data obtained from the farm model. The notable inclusion is the component of AOBH in figure 1 showing that, at least with this model, there is a place for AOBH systems to be included on East Coast North Island farms.

To assess whether this was an improvement on conventional systems another L.P. model was run that did not have the option of including an AOBH component. This model is called "Conventional Farm Model".

4.4 Conventional Farm Model

The "Conventional Farm Model" consists of the same inputs that the default model has with the exception of "turning off" the AOBH options.

When this model was run the option to include a spring based OBH system was left viable however the model chose not to utilise this option.

4.4.1 Financial Results

The financial results of this system return a net profit before tax and depreciation of $79,560 or a reduction of $16,912 or $28.18 per ha to $132.6 per ha. This is a decrease of approximately 18.2%

4.4.2 Pasture Efficiency

The amount of pasture utilised in this "conventional model" was 87.5% a reduction of .3%

4.4.3 Changes in stocking Composition

Summary of Conventional Farm Model Stock on Balance Date

Table 4.3

Sheep	Ewe Hoggets	2th Ewes	M.A. Ewes	Rams			
	616	573	1,562	34			
Cattle	R1yr Hfrs	R1yr Males	R2yr Hfrs	R2yr Males	R3yr Hfrs	M.A. Cows	Breeding Bulls.
	212	212	86	0	0	391	10

The total number of sheep is barely unchanged increasing by 9 from 2795 on the "Default Model" up to 2785 in this model.

The cattle numbers have increased to reach the 40% capacity allowed by the model and now total 911 animals compared to 830 in the "default model"

Summary of Conventional Farm Model

Table 4.4

Activity Level (Animal numbers)			
Total S/Us on an annual Basis			8,757
SUs per Ha on an annual Basis			14.59
SUs ME requirements			6,000
Feed Consumed (MJME/10.5 to convert)			87,569

Per hectare Supplied (MJME)			100,093
Total feed supplied Utilised			87.5%
Total farm Costs			-386,161
Gross income			465,721
Per ha			776
Net Farm Income			79,560
net per ha			133
Balance date S/U			7,706.39
S/Us per Ha			12.84

The final model to be run is a model with all restrictions removed, i.e. letting the model decide what ratio of sheep to cattle it should carry and when. This model is called the "Unrestricted Model".

4.5 Unrestricted Model

This model chose an all cattle option and was the most profitable of all systems tested.

4.5.1 Financial Results

The total net farm income before tax and depreciation is $145,979 or $49,507 ahead of the default farm model. This is an improvement of over 51%

Unrestricted Farm Model Summary

Table 4.5

Activity Level (Animal numbers)			
Total S/Us on an annual Basis			8,505
SUs per Ha on an annual Basis			14.17
SUs ME requirements			6,000
Feed Consumed (MJME/10.5 to convert)			85,048
Per hectare Supplied (MJME)			100,093
Total feed supplied Utilised			85.0%
Total farm Costs			-398,243
Gross income			544,222
Per ha			907
Net Farm Income			145,979
net per ha			243
Balance date S/U			8,504.84
S/Us per Ha			14.17

Summary of Unrestricted Model Stock on Balance Date

Table 4.6

Sheep	Ewe Hoggets	2th Ewes	M.A. Ewes	Rams			
	0	0	0	0			
Cattle	R1yr Hfrs	R1yr Males	R2yr Hfrs	R2yr Males	R3yr Hfrs	M.A. Cows	Breeding Bulls.
	428	306	336	0	196	628	15

4.5.6 Pasture Efficiency

This has decreased from 87.8% in the default model to 85%. An increasing concern with all the systems to date is the carrying over of feed from one month to the next. This model even though it has the greatest pasture efficiency measure is carrying the most pasture over with all the months from November to April carrying over in excess of 1000kgs of dm peaking at 1500 kgs in January.

If the cost of harvesting silage is reduced to zero per MJME then the model selects the silage making option and over September, October and November, harvests a total of 28ha which is fed out from April through to July. By doing this the model increases utilisation by 11.8% to 96.8% and lifts profits to$182,020

The tipping point for silage making appears to be .006cents per MJME from .009 cents as at this point it converts surpluses in September into silage

When run at .006 per MJME with the “Default Model” it also improved pasture efficiency with a lift from 87.8% to 90.1% and a corresponding lift in profits and stock carrying capacity

The “Conventional Model also had a similar result lifting efficiency to 89.9% a similar margin with the “Default Model” as before.

Hay takes a reduction in costs from .013cents per MJME to .06 cents before it starts to be made the improvements in efficiency are slower with the initial lift only to 89.2% efficiency. This is no doubt due to the reduced window the model allows hay to be made, December, January and February.

To warrant the expense of purchasing hay the price per MJME has to drop from .017 per MJME to .005cent per MJME. Fed out in July this hay has the effect of improving feed efficiency to 84.1% and lifts farm profitability to $95,699 a small lift of $550.

4.5.7 Price Sensitivity

To test what the tipping point was for the AOBH system, i.e. at what point the model no longer selected AOBH and reverted to the conventional model the returns to the various AOBH livestock returns were progressively reduced until at -13.5% the model switched from AOBH to conventional.

Sheep prices on the non-restricted model had to lift by 20% over all sheep and wool sold before the programme selected sheep over cattle.

4.6 Sheep Sensitivity

Due the to focus on sheep on most New Zealand properties the results that were obtained from the sensitivity of sheep returns are worthy of closer examination. As stated a 20% increase in all sheep and wool sold was required to shift the “unrestricted model” from being all cattle to the point where sheep were reintegrated into the model. A lift by 10% did not result in any changes. The 20% lift resulted in the sheep ratio going to 65% (cattle 35%) and pasture efficiency lifted to 87.5%. Another change was that silage was harvested in September and fed in July. The total carry over of feed from one month to another was also dramatically reduced from the previous 13553 MJME high to 857 MJME.

This model also chose to include the AOBH system in its cattle mix. This time it was at a slightly lower level with the AOBH herd being reduced from 74 cows calving to 68.

As this ratio of 65% sheep to 35% cattle was selected by the programme this ratio was then run on the “default model” with no other adjustments to see if pasture utilisation could be improved. In fact it actually reduced by .2% and profitability reduced by $5,000

Summary of sheep sensitivity results

Table 4.7

Activity Level (Animal numbers)			
Total S/Us on an annual Basis			8,757
SUs per Ha on an annual Basis			14.60
SUs ME requirements			6,000
Feed Consumed (MJME/10.5 to convert)			87,574
Per hectare Supplied (MJME)			100,093
Total feed supplied Utilised			87.5%
Total farm Costs			-391,863
Gross income			543,808
Per ha			906
Net Farm Income			151,944
net per ha			253
Balance date S/U			8,104.21
S/Us per Ha			13.51

Summary of Stock on Balance Date

Table 4.8

Sheep	Ewe Hoggets	2th Ewes	M.A. Ewes	Rams			
	745	693	1,888	41			
Cattle	R1yr Hfrs	R1yr Males	R2yr Hfrs	R2yr Males	R3yr Hfrs	M.A. Cows	Breeding Bulls.
	151	151	118	0	69	221	4

4.7 Spring OBH System.

The final sector to examine is what is required to change to bring the Spring OBH system into the system. For simplicities sake only Spring OBH heifer dams had their sale prices altered and it took a lift of 35% before they were considered as part of the farming system. They came in at the expense of the AOBH systems as there were no cull heifers left to go into the AOBH system once the spring OBH was satisfied.

Chapter 5
Discussion

5.1 Introduction

This chapter will discuss the results from the previous chapter and analysis what their implications are especially in relation to beef systems within New Zealand. Full details of the tables summarising the results can be found in the appendices section.

What is clear is that within this model and with the economics applied to it there is potential for a place for AOBH on East Coast farms of the North Island.
Summary of make up of livestock on models

Table 5.

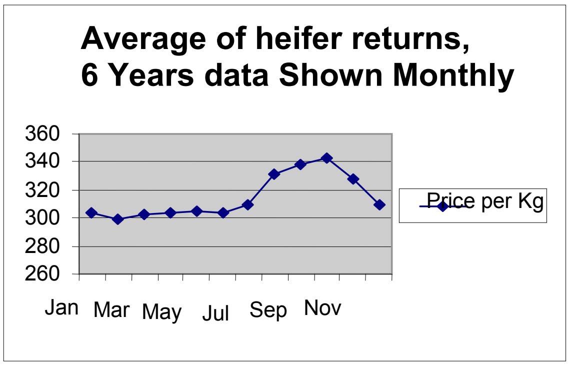
	Sheep Total	Ewe Hoggets	2th Ewes	M.A. Ewes	Rams			
Default	2795	619	575	1,567	34			
Conventional	2785	616	573	1,562	34			
Unrestricted	0	0	0	0	0			
Sheep sensitivity.	3367	745	693	1,888	41			
	Cattle Total	R1yr Hfrs	R1yr Males	R2yr Hfrs	R2yr Males	R3yr Hfrs (AOBH Dams)	M.A. Cows	Breeding Bulls.
Default	829	175	175	137	0	80	256	6
Conventional	911	212	212	86	0	0	391	10
Unrestricted	1909	428	306	336	0	196	628	15
Sheep sensitivity.	714	151	151	118	0	69	221	4

5.2 Reasons for Profitability of AOBH Systems

To test how robust the AOBH system is, the returns to the three year heifers had to be deflated by 22% before the programme went back to a more conventional system. As the sales of the progeny are at similar times to when other stock are being sold to deflate the progeny would not have achieved anything as parity with other cattle would have remained the same. The reason that the AOBH dams achieve such a high premium is due to their selling date coinciding with when there is the greatest demand for cattle, particularly cattle suitable for local trade, from processing companies.

A summary of the Local Trade heifer returns are shown on Graph 5.1 below. This clearly illustrates the seasonal nature of payouts by the processing companies

Graph 5.1



Based on AgriFax data 2001-2006

For spring OBHs to be sold at this time they would need to be carried for an extra six months and they still have the issue of adding to the spring workload when calving

5.3 Sheep Sensitivity

The prices used in the model being the average from the last six years which included some very good returns when compared to current returns especially sheep returns. This longer term averaging has reduced the current poor return effects. Even with “softening” of the current pricing sheep struggle to compete against cattle and it took a 20% increase in sheep prices to get the programme to incorporate sheep to any degree which is likely to reflect carrying on East Coast farms. While a 20% lift on the sheep returns is possible it is unlikely to occur with out seeing a similar lift in cattle prices. This is leads to the opinion that it is going to take a greater than 20% lift in sheep returns to get sheep to financially out perform this cattle system. The other issue what makes this result surprising is the high performance level of the ewe flock in this model. Hoggets are lambing at 85%, two tooths (2ths) lambing at 138% and the mixed age mob (M.A.) at 144%. There is room to improve the area around lamb selling with a wide spread of lamb sales from weaning through to June. Not surprising the model, if allowed, would have sold all lambs at weaning at reasonably modest returns so more stock could be carried. The reason the model was forced to carry lambs through was to better replicate farmers' behaviour. With interest on the capital value included into the costs of cattle the cost of "owning" breeding cows cannot be used as a reason not to increase the shift towards cattle.

5.4 Effect on Feed Supplies

The fact that the model with the AOBH system can achieve greater efficiencies with pasture utilisation, be it only by .3%, also indicates that there is no loss to the farms biological efficiencies. It was this area that was considered to likely to hinder the acceptance of the AOBH system. The reality on many farms is that this .3% benefit can be increased by utilising areas of the farm that are unsuitable to be grazed by breeding stock calving and lambing in the spring. These areas, such as forest blocks etc, can be grazed by rising 2year heifers that are unbred or in the early stages of pregnancy. Most farms, especially those which are mating hoggets and 15 month heifers do not have a "low priority" class of livestock over this period. If there is surplus feed, especially later in the spring, then the AOBH mob can be utilised to help control some of this. Again over this period they can utilise pasture that may not be suitable for priority finishing stock, acting in much the way breeding cows do.

The other period when there may be some conflict with other classes of stock is the autumn period. With the AOBH mob calving later in February and feeding a calf through until July they have higher demands through this period. The result is that they are potentially in direct conflict with finishing stock and breeding ewes being flushed. The programme indicates that there are feed surpluses carried over every month up to July indicating that no classes of stock are being compromised (with their given demands). Issues would arise if a dry spell or drought extended from the summer early autumn period into the late autumn winter period, such as has happened this year (2007). This problem is further explored under "Risk Management". However it needs to be remembered that spring based systems have no guarantees also with winter conditions often extending longer than expected and running into dry cool springs. The option of letting the programme sell all surplus lambs be they store or finished at weaning or early in the season would mitigate this risk to some degree. Lambs are likely to be the most vulnerable stock in a prolonged feed shortage over this period.

Within the default model the AOBH rearing calves only make up 6% of the total stock units so while they will have an impact it is concluded that this impact will be minimal.

The period after weaning (mid July) is possibly more critical with calves and dams needing to be provided with good quality feed to get them to target weights and thereby achieve budgets. A speciality finishing area for the heifers is likely to be needed to achieve this and the calves also requiring favourable treatment. It is this period that makes AOBH more likely to succeed in the warmer North Island regions with milder winters and earlier springs than cooler regions. What the existing calving and lambing dates are for the conventional mobs will also impact upon availability of feed. The default model has the ewes and lambing and cows calving in September. With this models feed supply the critical feed months are July and August if lambing and calving were moved back into August it is felt this would compound this issue.

5.4.1 Supplements

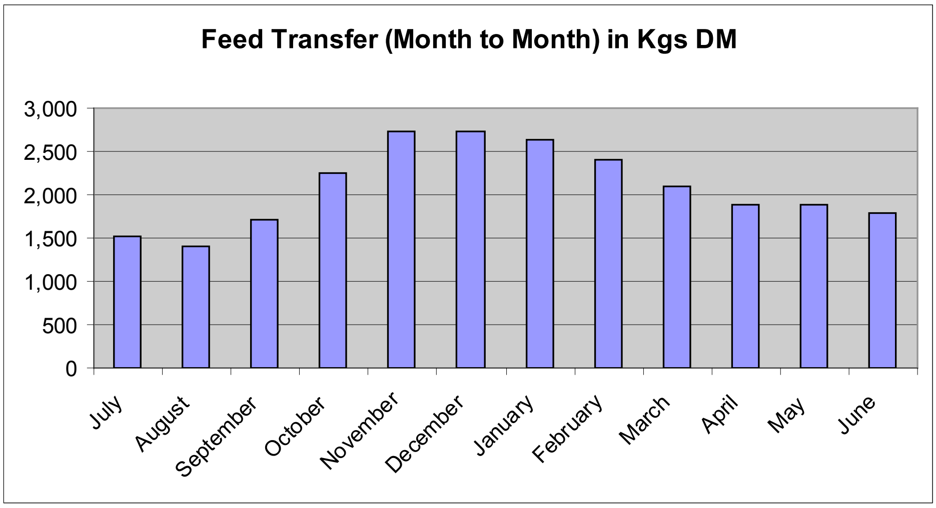
The model with the default inputs choose not make any supplements, given the feed surpluses carried forward this was some what surprising. In reality farmers for "peace of mind" are likely to create a stock pile of hay or silage even though they may be aware that it is not economically sound most years. The alternative would be to incorporate added sophistication into this area of the programme by adding in a nitrogen application option both for autumn and the late winter, spring period. Whether the programme would chose to use it with the current high cost of nitrogen, (MJME produced is in the vicinity of 1.3cents) more than silage (1.2 with feeding out costs) and the similar to hay. (1.25cent per MJME).

To get a more representative result the model may need to be "forced" to harvest supplements as farmers do make hay and silage etc to maintain feed quality as much as to create feed store supplies. A model was run achieving this by reducing the efficiency of carrying pasture over from one month to the next from 15% in the default model to 80% (this is an arbitrary figure chosen so that the L.P. would act upon it). The month selected was November as this was when the greatest carry over of pasture occurred and previous experimentation had found that when selecting several months the model only chose one and the reduced carry over efficiency figures distorted the overall farm feed utilisation efficiency. Selecting November lowered the overall pasture covers to an acceptable level i.e. keeping them between 1400 and 2500kgs dm and allowed 545,573MJME to be harvested in the form of silage which was then fed out in July when there is a "tight" period.

The graphs below show the covers before and after the programme was "encouraged" to harvest silage.

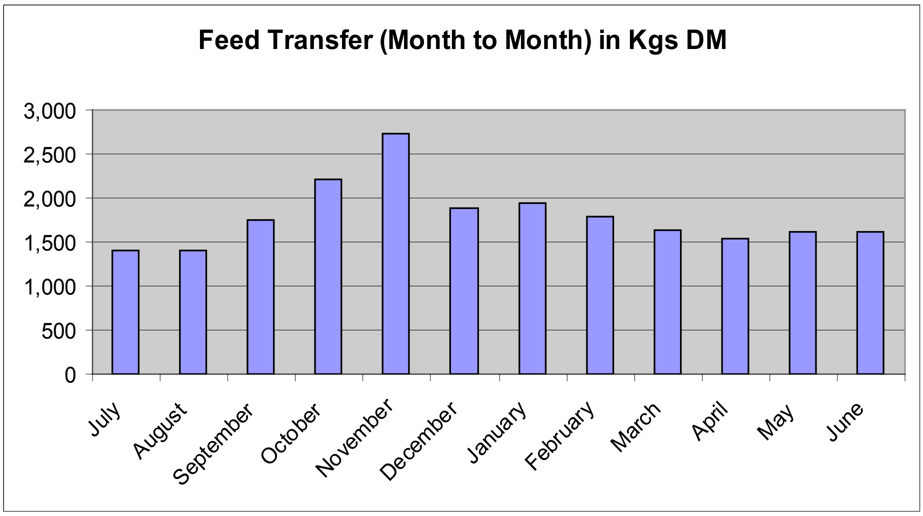
Graph 5.2

Feed Covers Prior to Silage harvesting on Default Model



Graph 5.3

Feed Covers on default Model Post Silage Harvesting



As can be seen in graph 5.3 only in November when the silage is to be harvested are the pasture covers over 2500kgs dm per ha and over 2000 kgs dm per ha one other time. Whereas in the previous graph covers exceed 2500kg dm per ha three times and 2000 kgs dm per ha six times. At the lower end there is very little difference in minimum covers.

To achieve these covers a starting value at the 1st of July of 1400kgs dm per ha was allocated and the feed transfers (surpluses) are added on to this.

In addition to altering pasture covers the harvesting of silage also had an impact on profitability, utilisation efficiency and stocking capacity. With all measures reducing after the silage harvest as the below table illustrates.

Table 5.1

Results of Default and Silage Harvest Model

Existing Default Figures		**Post Silage Harvest Model**
Pasture Utilised	82.60%	78.90%
S/Us per Ha	13.78	13.16
Farm Surplus	$95,923	$74,132

These results are not unexpected and are why the default model chose not to incorporate them in the first place.

The change in stock units was spread over all classes rather than in any particular area.

5.5 Labour Issues.

Due to the shifting of breeding dates away from the spring period, which is one of the critical times on a farm with calving, lambing, docking occurring and leading into shearing the AOBH does not compound labour and time issues around this period. When there is more work created with the AOBH system, around their calving time, conditions to carry out this work are generally more favourable with ground conditions dry, days a little longer and stock older and generally under less stress when compared to late winter early spring calving.

Apart from economics it is felt that the farmer “stress” issues involved with calving spring based OBH, i.e. potentially a high rate of assisted calvings and a higher cow and calf mortality rate, is a major reason beef farmers have chosen not to widely adopt the ONH system. Most farmers find getting a “good” result from yearling mated replacement heifers enough of a challenge without contributing to this challenge by mating cull animals. Especially when there is an increasing area of priority jobs to be done on the farm

5.6 Different Regions and Feed Supplies

When the programme was run with supply figures from Canterbury irrigated figures, Canterbury dryland figures and Northland figures no major changes occurred. The only other changes to the input figures was in the Canterbury irrigated model which had its set cost per ha lifted from $410 per ha to $600 to account for the extra costs of irrigation.

All models still choose to run with AOBH systems and none choose to harvest or purchase supplements. Again the carry over of surplus pasture from one month to next remains a concern. The Canterbury irrigated model had the highest utilisation of pasture with dryland Canterbury the lowest.

Chapter 6
Conclusions

6.1 Introduction

This chapter will cover the broad issues regarding how the AOBH system can contribute to the beef industry, what risks are involved in implementing such systems. Constraints of the current modelling programme will also be examined. Finally how useful Linear Programmes are as decision support tools especially in relation to other programmes already in existence will be discussed.

6.2 AOBH Systems Contribution to the Beef Industry.

Alistair Nicol is quoted as saying he believes that there is potential for an additional 100,000 heifers coming into the beef industry as OBH (1990). How many the AOBH system could potentially provide would depend upon how well the regional differences of climate and feed supply can be dealt with. If a management system could be found could be found where by all beef cow herds could adopt such a system then using 2004 figures (MAF2006) there are 1,108,669 two year old heifers or cows in beef breeding herds Allowing for half of the two year cattle not calving until they are three years old and with a 20% replacement rate then there are an estimated 1,000,000 cows calving every year. At a 90% calving rate and 50% of progeny being female (450,000) and then after the 20% replacement heifers are deducted there are a potential 270,000 heifers left whose breeding potential is not being utilised. When animals unsuitable to be bred from or remain dry at mating are deducted then it is possible that 200,000 extra heifers could be able to contribute into the beef industry on a annual basis.

To consider that having all these animals joining AOBH herds or that all their contribution, i.e. progeny and extra weight, will be additional to what is already being marketed is naïve, as although the additional amounts of pasture being utilised is not large and while there are extra profits, they are mitigated by what other systems have been reduced by to “make room” for the AOBH system. What this study does show that AOBH systems appear viable and worthy of additional study.

6.3 Risks

6.3.1 Marketing

The biggest risks to the system come from not achieving target live weights. This relates mainly to the heifers from the calving period leading up to when they are due to be slaughtered. The risk is that if the heifers have not reached the grading required for "Prime" grade heifer then they will either be required to be on the farm longer and run the risk of having their sixth tooth erupt and being down graded to manufacturing or creating a greater maintenance cost due to their extra time on the farm and this will be at the expense of other stock. One aspect of the system that has not been investigated is the potential of these heifers being sold for a premium over cow (manufacturing) as replacement animals for other herds. With October through to December being the mating period for many North Island herds, the availability of these surplus animals coincides with this period. The returns from this source are not likely to match that of processing companies for prime animals but may be ahead of the manufacturing price.
However, as discussed earlier, having sufficient feed of the quality required is critical to the success of the system at this stage.

The risk from overseas markets enforcing age restrictions on animals exported into them is also a risk that cannot be ignored. This area appears to have dropped below the horizon of our importing partners but it would only take another outbreak of B.S.E. to bring it back up again. The fact that New Zealand is considered safe from the disease greatly reduces this risk. If this scenario were to happen it is likely that steer and bull would also be encompassed in any trading restrictions placed upon New Zealand. The far reaching effects of this would mean such measures are likely to be forewarned to give producers some time to adjust. Overall this area of risk appears to be diminishing. *"Globally, the incidence of BSE in cattle is declining, as are consumer concerns about eating beef."* (SONZAF July 2006 update).

Competition from other developing producers, especially the South American countries is increasing with improved management increasing profitability and outputs increasing and more controls reducing the incidence of "foot and mouth" disease making more markets upon to them. Balanced against this United States and European beef production seems likely to decline or at least increase in price due to greater costs as a result of more corn being used as a source of bio-fuel creating a greater demand and cost for this food source for cattle.

Within New Zealand the already expressed competition for resources (land) from the dairy industry is going to be an ongoing issue plus if lamb meat economics improve then this may increase the decline of beef cow herds

Any supply issues relating to the withdrawing of existing supply of heifers from the local trade market is likely to be filled from the extra female progeny of the AOBH herds and the smaller AOBH dams still being likely to be directed to this market.

6.3.2 Climatic Risks

As the default model is based around East Coast conditions the potential for drought in the autumn is real. The model choose not to select supplements however with the large amounts of feed carried over from month to month and with most of this falling in months when it is quite possible to make silage or hay it would seem that even if the programme does not select to make supplements it would be both possible and wise to do so (as previously discussed). This may be at a small cost to farm financial and feed efficiency but should not affect the viability of the AOBH system or the programmes ability to select it as an option.

In the event of a prolonged or very severe drought or feed shortage then the ability always exists to sell the AOBH heifers at any stage. The most profitable result would be if the heifers are in a condition whereby they can be slaughtered for local trade or export. If this period of slaughter is approaching calving time (mid to late February) then the potential loss of future income is mitigated to some degree by the harvesting of "foetal bloods" i.e. the blood from the unborn calf which is used in the pharmaceutical industry. The returns that can be achieved from this are dependent upon the size of the unborn calf. This in turn is dependent on length of pregnancy when "harvested" and the age of the dam. For heifers at an optimum harvest time the returns achieved are likely to be in the vicinity of $150 per heifer.

The advantage of the AOBH system is that it can be withdrawn from the farming system (prior to calving) with out having an ongoing impact on the rest of the farming programme as would occur if selling "capital stock" and so contributes to farm flexibility. Once the heifers have calved then this flexibility is greatly reduced, having a supply of supplements to reduce the risk of having to sell heifers with calves at foot would be prudent management as it is unlikely other farms will have the feeding systems in place to capitalise on purchasing such animals and therefore AOBH and calves are likely to be severely discounted at sale time.

6.4 Constraints of the Current Modelling Programme.

This programme needs to be viewed as a "work in progress" it does have deficiencies which hopefully will be ironed out with the fullness of time. The current model was developed to specifically look at the issue of AOBH systems against a conventional system and as such appears to be successful in coming to a conclusion. Where it does have constraints is not having other potential farming systems which could have been included into the programme. These could include trading and finishing programmes such as steer and bull beef systems; both from weaned calves through to 18 month systems. Or lamb finishing systems which could involve the purchase of lambs or through belonging to a processing model such as the Bernard Matthews model in the North Island or the PPCS Lamb Plan in the South Island. As discussed earlier the "problem" of feed surpluses also needs to be re-examined, including the cost for moving feed with diminishing quality reflected in MJME per kg dm. While by increasing the "cost" of transferring feed did solve this issue to some degree, further work needs to be done to incorporate a more accurate way of doing this.

Another area where the programme has no flexibility is modifying feed demand by the different classes of stock. At present all the assumptions are done in the "Stock ME Requirements" this provides for weight gains and losses as the programmer dictates, currently they are set up as what it is believed is likely to occur on an average east Coast farm. For example breeding cows gain weight steadily over the summer at 35MJME required per kilogram of weight gain and then loses 10% of their weight over the winter period and "stimulates" 28 MJME per kilogram of weight lost. It would be interesting to see if the programme could add or lose weight at its discretion whether it could come up with a more efficient model. It may be possible to also allow the programme to move key events (within certain biological boundaries) such as calving and lambing dates to find which are optimal for the farming system adopted.

This same lack of flexibility also applies to the feed supply inputs, whilst they relate to what can be expected in two out of three years, the third year is also critical to the success of the farming programme. Having a programme which can include one in ten or even five year droughts etc would be an advantage.

Future development aims to try and remedy these shortfalls.

With the publication of new data relating to the MJME requirements of livestock now available (Nicol and Brookes 2007), the programme could be improved with the addition of this new information. The efficiency of both sheep and cattle is extremely important to the correct results being provided by the model. The L.P. will be adjusted to incorporate this new data.

The ultimate test of the programme would be by testing it in the field to see if its conclusions remain viable in "real" conditions.

6.5 L.P's in Comparison to Existing Programmes.

Currently there are in existence a number of very good feed budgeting type programmes. They range from simple Excel spreadsheet type programme up to the Farmax model which is probably the ultimate computer farm support programme for the sheep and beef industry. To date all these existing programmes appear to be programmes which require the farmer (or consultant) to enter the farming system i.e. numbers of ewes and cows etc and then the programme will provide the results of these inputs. L.Ps, and this programme as an example works the other way and the operator provides outcomes and inputs i.e. potential animal returns and feed supply etc and the programme comes up with the "optimal" system. Farmers do have an inherent understanding of what normally works best on their particular property and this programme does not wish to denigrate that knowledge. However a comprehensive L.P programme could provide a wide range of alternative systems the average farmer may not have been exposed to and as a result not be able to visualise how they may impact on the current farming system. As such it is felt that L.Ps in general have been under utilised in the New Zealand farming scene and a place is seen for them both as "stand alone" decision support tools or by working in conjunction with the likes of Farmax to provide more and better information for the Farmax model to work with. Complimenting the existing farm decision tools can only strengthen the information that farmers use for making decisions. With the changing climates and market places having additional information can only benefit the industry.

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Appendices

Appendix 1. Model LP.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	**East Coast Model**	Supply	Rel	Demand	Cattle S/Us	Sheep S/Us	Rams	Works @ Weaning Lambs	Ewe Lambs	Inlamb ewe Hoggets	2th Ewes	Terminal lambing Ewes	4th. Ewes	6th. Ewes	4 yr. Ewes	5 yr. Ewes	Sell female lambs March	Sell Works @ Weaning Lambs	Sell Works Jan Lambs	Sell Works March Lambs	Sell Works June Lambs	Sell Wool	Sell Cull/Terminal ewes
2	Land	600.00	<=	600.00																			
3	Hay Barn	0.00	<=	0.00																			
4	Silage pit	0.00	<=	0.00																			
5	July	0.00	<=	0			995	0	0	747	933	943	857	857	857	857	0	0	0	0	0		
6	August	0.00	<=	0			746	0	0	663	873	818	743	743	743	743	0	0	0	0	0		
7	September	0.00	<=	0			481	0	0	587	929	1,007	916	916	916	916	0	0	0	0	0		
8	October	0.00	<=	0			498	0	0	913	764	1,109	1,008	1,008	1,008	1,008	256	0	0	0	0		
9	November	0.00	<=	0			481	0	256	952	764	676	676	676	676	676	602	0	235	235	235		
10	December	0.00	<=	0			498	0	602	960	518	560	560	560	560	560	723	0	469	469	469		
11	January	0.00	<=	0			498	0	723	832	525	531	531	531	531	531	604	0	590	590	590		
12	February	0.00	<=	0			584	0	604	434	481	577	577	577	577	577	698	0	0	485	485		
13	March	0.00	<=	0			498	0	698	603	671	727	727	727	727	727	705	0	0	566	566		
14	April	0.00	<=	0			481	0	705	479	530	544	544	544	544	544	0	0	0	0	578		
15	May	0.00	<=	0			498	0	658	503	554	382	382	382	382	382	0	0	0	0	565		
16	June	0.00	<=	0			481	0	656	494	544	355	355	355	355	355	0	0	0	0	567		
17	Rams	0.00	<=	0.00			-1.00	0.00	0.00	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0	0	0		
18	ewelamb/hogget tie	0.00	<=	0.00					-1.00	1.00													
19	Hogget/2th tie	0.00	<=	0.00						-0.93	1.00												
20	2th/4th tie	0.00	<=	0.00							-0.86		1.00										
21	4th/6th tie	0.00	<=	0.00									-0.85	1.00									
22	6th/4yr tie	0.00	<=	0.00										-0.85	1.00								
23	4yr/5yr tie	0.00	<=	0.00											-0.85	1.00							
24	Flock/Terminal ewes tie	0.00	<=	0.00							-0.10	1.00	-0.10	-0.10	-0.10	-1.00							1.00
25	Ewe lamb tie	0.00	<=	0.00					1.00	0.00	-0.69	0.00	-0.72	-0.72	-0.72	-0.72	1.00						
26	Works Lamb tie	0.00	<=	0.00				1.00		-0.85	-0.69	-1.25	-0.72	-0.72	-0.72	-0.72			0.00				
27	Works @ Weaning Lambs\Sale tie	0.00	<=	0.00				-0.30										1.00					
28	Works Lamb \Jan Sale Tie	0.00	<=	0.00				-0.30											1.00				
29	Works Lamb \March Sale Tie	0.00	<=	0.00				-0.30												1.00			
30	Works Lamb \JuneSale Tie	0.00	<=	0.00				-0.10													1.00		
31	Wool Production	0.00	<=	0.00			-6.00		-0.70	-3.80	-4.20	-5.00	-5.50	-5.50	-5.30	-5.00						1.00	

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
32	R1yr Hfrs Replacements/2yr hfrs (wet)	0.00	<=	0.00																			
33	Replacement R2yr wet Hfrs/R3yrCows	0.00	<=	0.00																			
34	Replacement R3yrCows/R4yrCows	0.00	<=	0.00																			
35	Replacement R4yrCows/R5yrCows	0.00	<=	0.00																			
36	Replacement R5yrCows/R6yrCows	0.00	<=	0.00																			
37	Replacement R6yrCows/R7yrCows	0.00	<=	0.00																			
38	Replacement R7yrCows/R8yrCows	0.00	<=	0.00																			
39	Replacement R8yrCows/R9yrCows	0.00	<=	0.00																			
40	Replacement R9yrCows/R10yrCows	0.00	<=	0.00																			
41	10yr Cows/sale	0.00	<=	0.00																			
42	Cull Cow tie	0.00	<=	0.00																			
43	R1yr Sp.OBH/R2yr Sp OBH tie	0.00	<=	0.00																			
44	R2yrSp.OBH sales tie	0.00	<=	0.00																			
45	R1yr Aut.OBH/R2yr Aut OBH tie	0.00	<=	0.00																			
46	R2yr Aut.OBH/R3yr Aut OBH tie	0.00	<=	0.00																			
47	R3yrAut OBH sales tie	0.00	<=	0.00																			
48	Aut OBH Female calf tie	0.00	<=	0.00																			
49	Aut OBH male calf tie	0.00	<=	0.00																			
50	Aut OBH female calf\sales tie	0.00	<=	0.00																			
51	Aut OBH male calf\sales tie	0.00	<=	0.00																			
52	Male Calf tie	0.00	<=	0.00																			
53	Male calf/1yr (June sale) tie	0.00	<=	0.00																			
54	Male 1yr/ SalesR2yr tie	0.00	<=	0.00																			
55	Male R2yr/sale tie	0.00	<=	0.00																			
56	Female Calf tie	0.00	<=	0.00																			
57	Femalecalf/weaned heifer tie	0.00	<=	0.00																			
58	Weaned heifer/ June sale tie	1.00	<=	1.00																			
59	June R1yr heifers / June R2yr sale tie	0.00	<=	0.00																			
60	Breeding Bulls.	0.00	<=	0.00																			
61	Cattle S/Us	0.00	=	0.00	1.00																		
62	Sheep S/Us	0.00	=	0.00		1.00	-1.12	0.00	-0.82	-1.36	-1.35	-1.37	-1.31	-1.31	-1.31	-1.31	-0.60						
63	Stock Units	0.00	<=	0.00	0.60	-0.40																	
64	Switch	0.00	<=	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
65	cash	0.00		74,132			-47.50	-3.00	-10.90	-20.08	-21.83	-23.61	-23.61	-23.61	-23.61	-23.61	55.00	79.67	64.78	65.19	72.03	2.72	50.00
66	Activity Level (Animal numbers)				3,159	4,739	34	2,042	616	616	573	0	490	416	354	301	903	613	613	613	204	13,737	484
67	Total S/Us			7,898	40%	60%																	
68	SUs per Ha			13.16																			

	A	Z	AA	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY
1	**East Coast Model**	R2yr males	Weaned Heifer Calves to June Feed	R1yr heifers to R 2yr Heifers	R1yr Hfrs (Aut OBH)	R2yr Hfrs (Aut OBH)	R3yr Hfrs (Aut OBH)	R1y Aut OBH females prodgen	R1y Aut OBH male prodgeny	R1yr Hfrs (Spr OBH)	R2yr Hfrs (Spr OBH)	Replace ment 1yr Hfrs (wet)	Replace ment 2yr Hfrs (wet)	R3yr Cows	R4yr Cows	R5yr Cows	R6yr Cows	R7yr Cows	R8yr Cows	R9yr Cows	R10yr Cows	Sale of 10yr+ cows	Sale of R3yr Sp OBH	Sale of 3 yr Aut OBH	Female calf Sales (April)	Female R1yr Sales (June)
2	Land																									
3	Hay Barn																									
4	Silage pit																									
5	July	2,289	0	1,711	1,711	1,286	3,365	1,289	1,453	1,711	1,286	1,711	2,855	1,338	1,338	1,338	1,338	1,338	1,338	1,338	1,338					
6	August	2,518	0	1,927	1,927	1,585	2,783	1,336	1,808	1,927	1,585	1,927	3,084	2,112	2,112	2,112	2,112	2,112	2,112	2,112	2,112					
7	September	2,818	0	2,248	2,248	1,608	2,902	1,722	2,029	2,248	1,608	2,248	3,386	2,438	2,438	2,438	2,438	2,438	2,438	2,438	2,438					
8	October	3,011	0	2,397	2,397	1,662	3,222	2,066	2,202	2,397	1,662	2,397	2,715	2,742	2,742	2,742	2,742	2,742	2,742	2,742	2,742					
9	November	3,010	0	2,887	2,887	2,268		2,106	2,233	2,887	2,268	2,887	2,627	3,133	3,133	3,133	3,133	3,133	3,133	3,133	3,133					
10	December	3,205	0	2,572	2,572	2,381		2,279	2,408	2,572	2,381	2,572	3,237	3,509	3,509	3,509	3,509	3,509	3,509	3,509	3,509					
11	January	2,681	0	1,962	1,962	2,596		1,887	2,211	1,962	2,596	1,962	3,096	3,853	3,853	3,853	3,853	3,853	3,853	3,853	3,853					
12	February	2,613	0	1,799	1,799	2,855		1,661	1,791	1,799	2,855	1,799	2,964	3,590	3,590	3,590	3,590	3,590	3,590	3,590	3,590					
13	March	3,107	0	2,701	2,701	3,369		2,173	2,415	2,701	3,369	2,701	2,707	3,259	3,259	3,259	3,259	3,259	3,259	3,259	3,259					
14	April	3,379	1,352	3,176	3,176	3,846		2,266	2,604	3,176	3,846	3,176	2,665	2,104	2,104	2,104	2,104	2,104	2,104	2,104	2,104					
15	May	3,579	1,481	2,524	2,524	4,040		2,319	2,783	2,524	4,040	2,524	2,798	2,164	2,164	2,164	2,164	2,164	2,164	2,164	2,164					
16	June	3,551	1,806	2,489	2,489	4,507		2,310	2,496	2,489	4,507	2,489	2,752	2,156	2,156	2,156	2,156	2,156	2,156	2,156	2,156					
17	Rams																									
18	ewelamb/hogget tie																									
19	Hogget/2th tie																									
20	2th/4th tie																									
21	4th/6th tie																									
22	6th/4yr tie																									
23	4yr/5yr tie																									
24	Flock/Terminal ewes tie																									
25	Ewe lamb tie																									
26	Works Lamb tie																									
27	Works @ Weaning Lambs\Sale tie																									
28	Works Lamb \Jan Sale Tie																									
29	Works Lamb \March Sale Tie																									
30	Works Lamb \JuneSale Tie																									
31	Wool Production																									
32	R1yr Hfrs Replacements/2yr hfrs (wet)											-0.99	1.00													
33	Replacement R2yr wet Hfrs/R3yrCows												-0.80	1.00												
34	Replacement R3yrCows/R4yrCows													-0.90	1.00											
35	Replacement R4yrCows/R5yrCows														-0.90	1.00										
36	Replacement R5yrCows/R6yrCows															-0.90	1.00									
37	Replacement R6yrCows/R7yrCows																-0.90	1.00								
38	Replacement R7yrCows/R8yrCows																	-0.90	1.00							
39	Replacement R8yrCows/R9yrCows																		-0.90	1.00						
40	Replacement R9yrCows/R10yrCows																			-0.90	1.00					
41	10yr Cows/sale																									
42	Cull Cow tie												-0.14	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.98	1.00				
43	R1yr Sp.OBH/R2yr Sp OBH tie									-0.99	1.00															
44	R2yrSp.OBH sales tie										-0.94												1.00			

	A	Z	AA	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY
1	**East Coast Model**	R2yr males	Weaned Heifer Calves to June Feed	R1yr heifers to R 2yr Heifers	R1yr Hfrs (Aut OBH)	R2yr Hfrs (Aut OBH)	R3yr Hfrs (Aut OBH)	R1y Aut OBH females prodgen	R1y Aut OBH male prodgeny	R1yr Hfrs (Spr OBH)	R2yr Hfrs (Spr OBH)	Replacement 1yr Hfrs (wet)	Replacement 2yr Hfrs (wet)	R3yr Cows	R4yr Cows	R5yr Cows	R6yr Cows	R7yr Cows	R8yr Cows	R9yr Cows	R10yr Cows	Sale of 10yr+ cows	Sale of R3yr Sp OBH	Sale of 3 yr Aut OBH	Female calf Sales (April)	Female R1y Sales (June
45	R1yr Aut.OBH/R2yr Aut OBH tie				-0.99	1.00																				
46	R2yr Aut.OBH/R3yr Aut OBH tie					-0.99	1.00																			
47	R3yrAut OBH sales tie						-0.98																	1.00		
48	Aut OBH Female calf tie						-0.45	1.00																		
49	Aut OBH male calf tie						-0.45		1.00																	
50	Aut OBH female calf\sales tie							-1.00																		
51	Aut OBH male calf\sales tie								-1.00																	
52	Male Calf tie										-0.40		-0.42	-0.45	-0.45	-0.45	-0.45	-0.45	-0.45	-0.45	-0.45					
53	Male calf/1yr (June sale) tie																									
54	Male 1yr/ SalesR2yr tie	1.00																								
55	Male R2yr/sale tie	-1.00																								
56	Female Calf tie		1.00		0.00					0.00	-0.40	0.00	-0.42	-0.45	-0.45	-0.45	-0.45	-0.45	-0.45	-0.45	-0.45				1.00	
57	Femalecalf/weaned heifer tie		-1.00		1.00					1.00		1.00													1.00	
58	Weaned heifer/ June sale tie			1.00																						1.0
59	June R1yr heifers / June R2yr sale tie			-1.00																						
60	Breeding Bulls.	0.00		0.00		-0.02					0.02	0.00	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02					
61	Cattle S/Us	-5.96	-0.77	-4.73	-4.73	-5.33	-2.05	-3.90	-4.41	-4.73	-5.33	-4.73	-5.81	-5.40	-5.40	-5.40	-5.40	-5.40	-5.40	-5.40	-5.40					
62	Sheep S/Us																									
63	Stock Units																									
64	Switch	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
65	cash	-104.00	-10.00	-56.75	-59.00	-115.50	-38.12	-54.00	-67.00	-61.00	-150.00	-61.00	-150.00	-125.40	-125.40	-125.40	-125.40	-125.40	-125.40	-125.40	-82.76	558.32	699.61	950.10	350.00	480.0
66	Activity Level (Animal numbers)	0	125	0	74	73	72	33	33	0	0	51	51	41	37	33	30	27	24	22	19	47	0	71	0	
67	Total S/Us																									
68	SUs per Ha																									

	A	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT
1	**East Coast Model**	Female R2yr Sales (June)	Male Calf Sales (April)	Male R1yr Sales (June)	Male 2 yr sales (June)	Sale of Aut OBH female calves	Sale of Aut OBH male calves	Breeding Bulls.	July	August	September	October	November	December	January	February	March	April	May	June	Silage Made September	Silage Made October
2	Land																					
3	Hay Barn																					
4	Silage pit																				-1.00	-1.00
5	July							2,000.00	-0.85	1.00												
6	August							2,000.00		-0.85	1.00											
7	September							2,000.00			-0.85	1.00									1.00	
8	October							2,000.00				-0.85	1.00									1.00
9	November							2,000.00					-0.20	1.00								
10	December							2,000.00						-0.85	1.00							
11	January							2,000.00							-0.85	1.00						
12	February							2,000.00								-0.85	1.00					
13	March							2,000.00									-0.85	1.00				
14	April							2,000.00										-0.85	1.00			
15	May							2,000.00											-0.85	1.00		
16	June							2,000.00	1.00											-0.85		
17	Rams																					
18	ewelamb/hogget tie																					
19	Hogget/2th tie																					
20	2th/4th tie																					
21	4th/6th tie																					
22	6th/4yr tie																					
23	4yr/5yr tie																					
24	Flock/Terminal ewes tie																					
25	Ewe lamb tie																					
26	Works Lamb tie																					
27	Works @ Weaning Lambs\Sale tie																					
28	Works Lamb \Jan Sale Tie																					
29	Works Lamb \March Sale Tie																					
30	Works Lamb \JuneSale Tie																					
31	Wool Production																					
32	R1yr Hfrs Replacements/2yr hfrs (wet)																					
33	Replacement R2yr wet Hfrs/R3yrCows																					
34	Replacement R3yrCows/R4yrCows																					
35	Replacement R4yrCows/R5yrCows																					
36	Replacement R5yrCows/R6yrCows																					
37	Replacement R6yrCows/R7yrCows																					
38	Replacement R7yrCows/R8yrCows																					
39	Replacement R8yrCows/R9yrCows																					
40	Replacement R9yrCows/R10yrCows																					
41	10yr Cows/sale																					
42	Cull Cow tie																					
43	R1yr Sp.OBH/R2yr Sp OBH tie																					
44	R2yrSp.OBH sales tie																					

	A	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT
1	**East Coast Model**	Female R2yr Sales (June)	Male Calf Sales (April)	Male R1yr Sales (June)	Male 2 yr sales (June)	Sale of Aut OBH female calves	Sale of Aut OBH male calves	Breeding Bulls.	July	August	September	October	November	December	January	February	March	April	May	June	Silage Made September	Silage Made October
45	R1yr Aut.OBH/R2yr Aut OBH tie																					
46	R2yr Aut.OBH/R3yr Aut OBH tie																					
47	R3yrAut OBH sales tie																					
48	Aut OBH Female calf tie																					
49	Aut OBH male calf tie																					
50	Aut OBH female calf\sales tie					1.00																
51	Aut OBH male calf\sales tie						1.00															
52	Male Calf tie		1.00																			
53	Male calf/1yr (June sale) tie			1.00	0.00																	
54	Male 1yr/ SalesR2yr tie																					
55	Male R2yr/sale tie				1.00																	
56	Female Calf tie																					
57	Femalecalf/weaned heifer tie																					
58	Weaned heifer/ June sale tie																					
59	June R1yr heifers / June R2yr sale tie	1.00																				
60	Breeding Bulls.							-1.00														
61	Cattle S/Us							-5.00														
62	Sheep S/Us																					
63	Stock Units																					
64	Switch	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
65	cash	650.00	480.00	550.00	918.77	680.00	785.61	-317.40	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.009	-0.009
66	Activity Level (Animal numbers)	0	0	125	0	33	33	4	0	0	2,228,570	5,303,039	8,139,621	2,894,806	3,206,530	2,102,718	1,333,843	821,152	1,216,883	1,178,739	545,573	0
67	Total S/Us																					
68	SUs per Ha																					

	A	BU	BV	BW	BX	BY	BZ	CA	CB	CC	CD	CE	CF	CG	CH	CI	CJ	CK	CL	CM	CN	CO
1	**East Coast Model**	Silage Made November	Silage Made December	Silage Made January	Silage Made February	Silage Made March	Silage Fed February	Silage Fed March	Silage Fed April	Silage Fed May	Silage Fed June	Silage Fed July	Silage Fed August	Silage Fed Septembe r	Hay Purchase d	Hay Made December	Hay Made January	Hay Made February	Hay Fed June	Hay Fed July	Hay Fed August	Pasture(HB Fertile)
2	Land																					1.00
3	Hay Barn														-1.00	-1.00	-1.00	-1.00	1.00	1.00	1.00	
4	Silage pit	-1.00	-1.00	-1.00	-1.00	-1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00								
5	July											-0.85								-0.85		-5,007
6	August												-0.85								-0.85	-9,391
7	September													-0.85								-12,944
8	October																					-13,375
9	November	1.00																				-9,884
10	December		1.00													1						-9,750
11	January			1.00													1					-7,489
12	February				1.00		-0.85								1.00			1				-6,569
13	March					1.00		-0.85														-7,926
14	April								-0.85													-7,247
15	May									-0.85												-6,198
16	June										-0.85								-0.85			-4,315
17	Rams																					
18	ewelamb/hogget tie																					
19	Hogget/2th tie																					
20	2th/4th tie																					
21	4th/6th tie																					
22	6th/4yr tie																					
23	4yr/5yr tie																					
24	Flock/Terminal ewes tie																					
25	Ewe lamb tie																					
26	Works Lamb tie																					
27	Works @ Weaning Lambs\Sale tie																					
28	Works Lamb \Jan Sale Tie																					
29	Works Lamb \March Sale Tie																					
30	Works Lamb \JuneSale Tie																					
31	Wool Production																					
32	R1yr Hfrs Replacements/2yr hfrs																					
33	Replacement R2yr wet																					
34	Replacement R3yrCows/R4yrCows																					
35	Replacement R4yrCows/R5yrCows																					
36	Replacement R5yrCows/R6yrCows																					
37	Replacement R6yrCows/R7yrCows																					
38	Replacement R7yrCows/R8yrCows																					
39	Replacement R8yrCows/R9yrCows																					
40	Replacement R9yrCows/R10yrCows																					
41	10yr Cows/sale																					
42	Cull Cow tie																					
43	R1yr Sp.OBH/R2yr Sp OBH tie																					
44	R2yrSp.OBH sales tie																					

	A	BU	BV	BW	BX	BY	BZ	CA	CB	CC	CD	CE	CF	CG	CH	CI	CJ	CK	CL	CM	CN	CO
1	**East Coast Model**	Silage Made November	Silage Made December	Silage Made January	Silage Made February	Silage Made March	Silage Fed February	Silage Fed March	Silage Fed April	Silage Fed May	Silage Fed June	Silage Fed July	Silage Fed August	Silage Fed September	Hay Purchased	Hay Made December	Hay Made January	Hay Made February	Hay Fed June	Hay Fed July	Hay Fed August	Pasture(HB Fertile)
45	R1yr Aut.OBH/R2yr Aut OBH tie																					
46	R2yr Aut.OBH/R3yr Aut OBH tie																					
47	R3yrAut OBH sales tie																					
48	Aut OBH Female calf tie																					
49	Aut OBH male calf tie																					
50	Aut OBH female calf\sales tie																					
51	Aut OBH male calf\sales tie																					
52	Male Calf tie																					
53	Male calf/1yr (June sale) tie																					
54	Male 1yr/ SalesR2yr tie																					
55	Male R2yr/sale tie																					
56	Female Calf tie																					
57	Femalecalf/weaned heifer tie																					
58	Weaned heifer/ June sale tie																					
59	June R1yr heifers / June R2yr sale tie																					
60	Breeding Bulls.																					
61	Cattle S/Us																					
62	Sheep S/Us																					
63	Stock Units																					
64	Switch	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
65	cash	-0.006	-0.006	-0.009	-0.009	-0.009	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003	-0.017	-0.013	-0.013	-0.013				-410.00
66	Activity Level (Animal numbers)	0	0	0	0	0	0	0	0	0	0	545,573	0	0	0	0	0	0	0	0	0	600
67	Total S/Us																					
68	SUs per Ha																					

Appendix 2. Livestock requirements

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	**ME Requirements of Stock**															
2			31	31	30	31	30	31	31	28	31	30	31	30		
3	**Period**		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN		
4	**Season**		Winter	Winter	Spring	Spring	Summer	Summer	Summer	Summer	Autumn	Autumn	Winter	Winter		
5	MJ ME/kgDM		11.2	11.2	11.8	11.8	10	10	10	10	10.8	10.8	11.2	11.2		
6	R 2 Yr Heifers (Dry)															
7	Average Weight		406	419	431	443	453	461	468	476	483	491	496	499		
8	Maintenance (0.6 MJ ME/kg^0.75)		54.3	55.5	56.7	57.9	58.9	59.7	60.4	61.1	61.8	62.6	63.1	63.4		
9	LWG : at MJ ME/kg LWG:	55.7	22.3	22.3	22.3	22.3	13.9	13.9	13.9	13.9	13.9	13.9	5.6	5.6		
10	TOTAL ME:		76.6	77.8	79.0	80.2	72.8	73.6	74.3	75.0	75.7	76.5	68.6	68.9		
11	kgDM/hd/day:		6.8	6.9	6.7	6.8	7.3	7.4	7.4	7.5	7.0	7.1	6.1	6.2		
12	Days		31	31	30	31	30	31	31	28	31	30	31	30		
13	Monthly Requirements.		2374	2412	2370	2487	2185	2281	2304	2101	2348	2294	2128	2068		
14	**Period**		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN		
15	**Season**		Winter	Winter	Spring	Spring	Summer	Summer	Summer	Summer	Autumn	Autumn	Winter	Winter		
16	MJ ME/kgDM		11.2	11.2	11.8	11.8	10	10	10	10	10.8	10.8	11.2	11.2		
29																
30	M.A. Cows														S/U comsumption	
31	Average Weight		491	485	482	482	482	488	494	503	509	509	509	500	6000	S/Us
32	Maintenance (0.55 MJ ME/kg^0.75)	0.55	57.4	56.8	56.6	56.6	56.6	57.1	57.6	58.4	58.9	58.9	58.9	58.2		
33	LWG : at MJ ME/kg LWG:	35	0.0	0.0	0.0											
34	ME for weight gain		-0.2	-0.1	0.0	0.0	0.2	0.2	0.3	0.2	0.0	0.0	-0.3	-0.3		
35	LWG : at MJ ME/kg LW Loss	28	-14.0	-2.8	0.0	0.0	7.0	7.0	10.5	7.0	11.2	11.2	11.2	14.0		
36	Pregnacy and Calf		57.4	71.0	81.3	88.5	97.2	106.0	113.5	121	93.9	58.9	58.9	58.2		
37	TOTAL ME:		43.2	68.1	81.3	88.5	104.4	113.2	124.3	128.2	105.1	70.1	69.8	71.9		
38	kgDM/hd/day:		3.9	6.1	6.9	7.5	10.4	11.3	12.4	12.8	9.7	6.5	6.2	6.4		
39	Days		31	31	30	31	30	31	31	28	31	30	31	30		
40	Monthly Requirements.		1338	2112	2438	2742	3133	3509	3853	3590	3259	2104	2164	2156	32397	5.40
41	**Period**		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN		
42	**Season**		Winter	Winter	Spring	Spring	Summer	Summer	Summer	Summer	Autumn	Autumn	Winter	Winter		
43	MJ ME/kgDM		11.2	11.2	11.8	11.8	10	10	10	10	10.8	10.8	11.2	11.2		
44	R 1 Yr Heifer (Dry and Wet)															
45	Average Weight		211	223	239	260	281	311	333	342	351	373	403	418		
46	Maintenance (0.6 MJ ME/kg^0.75)		33.2	34.7	36.4	38.8	41.2	44.5	46.8	47.8	48.6	50.9	53.9	55.5		
47	ME for LWG	55	22.0	27.5	38.5	38.5	55.0	38.5	16.5	16.5	38.5	55.0	27.5	27.5		
48	Daily wgt gain		0.4	0.5	0.7	0.7	1.0	0.7	0.3	0.3	0.7	1.0	0.5	0.5		
49	TOTAL ME:		55.2	62.2	74.9	77.3	96.2	83.0	63.3	64.3	87.1	105.9	81.4	83.0		
50	kgDM/hd/day:		4.9	5.5	6.4	6.6	9.6	8.3	6.3	6.4	8.1	9.8	7.3	7.4		
51	Days		31	31	30	31	30	31	31	28	31	30	31	30		
52	Monthly Requirements.		1711	1927	2248	2397	2887	2572	1962	1799	2701	3176	2524	2489	*	

	A	E	F	G	H	I	J	K	L	M	N	O	P
53	**Period**	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN		
54	**Season**	Spring	Spring	Summer	Summer	Summer	Summer	Autumn	Autumn	Winter	Winter		
55	MJ ME/kgDM	11.8	11.8	10	10	10	10	10.8	10.8	11.2	11.2		
56	R 2 Yr Heifers (Autumn Calving)												
57	Average Weight	399.5	399.5	399.5	411.5	423.9	433.2	441.6	454.0	466.0	478.4		
58	Maintenance (0.6 MJ ME/kg^0.75)	53.6	53.6	53.6	54.8	56.0	57.0	57.8	59.0	60.2	61.4		
59	ME for LWG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
60	Daily wgt gain	0.0	0.0	0.4	0.4	0.3	0.3	0.4	0.4	0.4	0.5		
61	LWG : at MJ ME/kg LW Loss	0.0	0.0	22.0	22.0	16.5	16.5	22.0	22.0	22.0	27.5		
62	Allowance for Pregnancy and Calf	0.0	0.0	0.0	0.0	11.2	28.5	28.9	47.2	48.1	61.4		
63	TOTAL ME:	53.6	53.6	75.6	76.8	83.8	102.0	108.7	128.2	130.3	150.2		
64	kgDM/hd/day:	4.5	4.5	7.6	7.7	8.4	10.2	10.1	11.9	11.6	13.4		
65	Days	30	31	30	31	31	28	31	30	31	30		
66	Monthly Requirements.	1608	1662	2268	2381	2596	2855	3369	3846	4040	4507	32004	5
67	**Period**	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN		
68	**Season**	Spring	Spring	Summer	Summer	Summer	Summer	Autumn	Autumn	Winter	Winter		
69	MJ ME/kgDM	11.8	11.8	10	10	10	10	10.8	10.8	11.2	11.2		
70	R 3 Yr Heifer3 (Autumn Calved OBH												
71	Average Weight	503.2	521.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
72	Maintenance (0.6 MJ ME/kg^0.75)	63.7	65.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
73	ME for LWG	33.0	38.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
74	Daily wgt gain	0.6	0.7										
75	Allowance for Pregnancy and Calf												
76	TOTAL ME:	96.7	103.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
77	kgDM/hd/day:	8.2	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
78	Days	30	31	30	31	31	28	31	30	31	30		
79	Monthly Requirements.	2902	3222	0	0	0	0	0	0	0	0		
80	**Period**	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN		
81	**Season**	Spring	Spring	Summer	Summer	Summer	Summer	Autumn	Autumn	Winter	Winter		
82	MJ ME/kgDM	11.8	11.8	10	10	10	10	10.8	10.8	11.2	11.2		
83	R 2 Yr Heifers (Spring Calving OBH)												
84	Average Weight	432.6	447.6	447.6	447.6	453.8	456.9	462.5	478.0	493.0	508.5		
85	Maintenance (0.6 MJ ME/kg^0.75)	56.9	58.4	58.4	58.4	59.0	59.3	59.8	61.3	62.8	64.2		
86	ME for LWG	27.5	0.0	0.0	11.0	5.5	11.0	27.5	27.5	27.5	27.5		
87	Daily weight gain	0.5	0.0	0.0	0.2	0.1	0.2	0.5	0.5	0.5	0.5		
88	Allowance for Pregnancy and Calf	28.5	29.2	29.2	35.0	35.4	35.6						
89	TOTAL ME:	112.9	87.6	87.6	104.4	99.9	105.9	87.3	88.8	90.3	91.7		
90	kgDM/hd/day:	9.6	7.4	8.8	10.4	10.0	10.6	8.1	8.2	8.1	8.2		
91	Days	30	31	30	31	31	28	31	30	31	30		

	A	E	F	G	H	I	J	K	L	M	N	O	P
92	Monthly Requirements.	3386	2715	2627	3237	3096	2964	2707	2665	2798	2752		
93	**Period**	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN		
94	**Season**	Spring	Spring	Summer	Summer	Summer	Summer	Autumn	Autumn	Winter	Winter		
95	MJ ME/kgDM	11.8	11.8	10	10	10	10	10.8	10.8	11.2	11.2		
96	Breeding Bulls												
97	Average Weight	900.0	900.0	900.0	900.0	900.0	900.0	900.0	900.0	900.0	900.0		
98	Maintenance (0.6 MJ ME/kg^0.75)	98.6	98.6	98.6	98.6	98.6	98.6	98.6	98.6	98.6	98.6		
99	LWG : at MJ ME/kg LWG:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
100	TOTAL ME:	98.6	98.6	98.6	98.6	98.6	98.6	98.6	98.6	98.6	98.6		
101	kgDM/hd/day:	8.4	8.4	9.9	9.9	9.9	9.9	9.1	9.1	8.8	8.8		
102	Days	30	31	30	31	31	28	31	30	31	30		
103	Monthly Requirements.	2958	3056	2958	3056	3056	2761	3056	2958	3056	2958		
104	**Period**	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN		
105	**Season**	Spring	Spring	Summer	Summer	Summer	Summer	Autumn	Autumn	Winter	Winter		
106	MJ ME/kgDM	11.8	11.8	10	10	10	10	10.8	10.8	11.2	11.2		
107	Heifer Calves (Spring Born)												
108	Average Weight	0.0	0.0	0.0	0.0	0.0	0.0	191	203	218	240		
109	Maintenance (0.6 MJ ME/kg^0.75)	0.0	0.0	0.0	0.0	0.0	0.0	30.8	33.4	35.8	38.3		
110	ME for LWG	0.0	0.0	0.0	0.0	0.0	0.0	12.8	16.0	22.4	16.0		
111	Daily weight gain							0.4	0.5	0.7	0.5		
112	TOTAL ME:	0.0	0.0	0.0	0.0	0.0	0.0	43.6	49.4	58.2	54.3		
113	kgDM/hd/day:	0.0	0.0	0.0	0.0	0.0	0.0	4.0	4.6	5.2	4.8		
114	Days	30	31	30	31	31	28	31	30	31	30		
115	Monthly Requirements.							1352	1481	1806	1628		
116	**Period**	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN		
117	**Season**	Spring	Spring	Summer	Summer	Summer	Summer	Autumn	Autumn	Winter	Winter		
118	MJ ME/kgDM	11.8	11.8	10	10	10	10	10.8	10.8	11.2	11.2		
119	Bull Calves (Spring Born)												
120	Average Weight	0.0	0.0	0.0	0.0	0.0	0.0	211	223	241	260		
121	Maintenance (0.6 MJ ME/kg^0.75)	0.0	0.0	0.0	0.0	0.0	0.0	33.2	34.7	36.7	38.8		
122	ME for LWG	0.0	0.0	0.0	0.0	0.0	0.0	12.8	19.2	19.2	22.4		
123	Daily weight gain							0.4	0.6	0.6	0.7		
124	TOTAL ME:	0.0	0.0	0.0	0.0	0.0	0.0	46.0	53.9	55.9	61.2		
125	kgDM/hd/day:	0.0	0.0	0.0	0.0	0.0	0.0	4.3	5.0	5.0	5.5		
126	Days	30	31	30	31	31	28	31	30	31	30		
127	Monthly Requirements							1426	1616	1734	1837		

	A	E	F	G	H	I	J	K	L	M	N	O	P
128	**Period**	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN		
129	**Season**	Spring	Spring	Summer	Summer	Summer	Summer	Autumn	Autumn	Winter	Winter		
130	MJ ME/kgDM	11.8	11.8	10	10	10	10	10.8	10.8	11.2	11.2		
131	Heifer Calves (Autumn born)												
132	Average Weight	199	223	254	284	315	331	342	364	388	409		
133	Maintenance (0.6 MJ ME/kg^0.75)	31.8	34.6	38.2	41.5	44.9	46.5	47.7	49.9	52.4	54.6		
134	ME for LWG	25.6	32.0	32.0	32.0	16.0	12.8	22.4	25.6	22.4	22.4		
135	TOTAL ME:	57.4	66.6	70.2	73.5	60.9	59.3	70.1	75.5	74.8	77.0		
136	Daily weight gain	0.8	1.0	1.0	1.0	0.5	0.4	0.7	0.8	0.7	0.7		
137	kgDM/hd/day:	4.9	5.6	7.0	7.4	6.1	5.9	6.5	7.0	6.7	6.9		
138	Days	30	31	30	31	31	28	31	30	31	30		
139	Monthly Requirements.	1722	2066	2106	2279	1887	1661	2173	2266	2319	2310		
140	**Period**	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN		
141	**Season**	Spring	Spring	Summer	Summer	Summer	Summer	Autumn	Autumn	Winter	Winter		
142	MJ ME/kgDM	11.8	11.8	10	10	10	10	10.8	10.8	11.2	11.2		
143	Bull Calves (Autumn Born)												
144	Average Weight	232	262	293	323	354	375	387	411	441	472		
145	Maintenance (0.6 MJ ME/kg^0.75)	35.6	39.0	42.4	45.7	48.9	51.2	52.3	54.8	57.8	60.8		
146	ME for LWG	32.0	32.0	32.0	32.0	22.4	12.8	25.6	32.0	32.0	22.4		
147	TOTAL ME:	67.6	71.0	74.4	77.7	71.3	64.0	77.9	86.8	89.8	83.2		
148	Daily weight gain	1.0	1.0	1.0	1.0	0.7	0.4	0.8	1.0	1.0	0.7		
149	kgDM/hd/day:	5.7	6.0	7.4	7.8	7.1	6.4	7.2	8.0	8.0	7.4		
150	Days	30	31	30	31	31	28	31	30	31	30		
151	Monthly Requirements.	2029	2202	2233	2408	2211	1791	2415	2604	2783	2496		
152	**Period**	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN		
153	**Season**	Spring	Spring	Summer	Summer	Summer	Summer	Autumn	Autumn	Winter	Winter		
154	MJ ME/kgDM	11.8	11.8	10	10	10	10	10.8	10.8	11.2	11.2		
155	R2yr Males (Spring Born)												
156	Average Weight	306.35	336.35	367.35	397.35	428.35	446.95	466.55	491.35	521.35	552.35		
157	Maintenance (0.6 MJ ME/kg^0.75)	44	47	50	53	56	58	60	63	65	68		
158	ME for LWG	50	50	50	50	30	35	40	50	50	50		
159	TOTAL ME:	94	97	100	103	86	93	100	113	115	118		
160	Daily weight gain	1	1	1	1	0.6	0.7	0.8	1	1	1		
161	kgDM/hd/day:	8.0	8.2	10.0	10.3	8.6	9.3	9.3	10.4	10.3	10.6		
162	Days	30	31	30	31	31	28	31	30	31	30		
163	Monthly Requirements.	2818	3011	3010	3205	2681	2613	3107	3379	3579	3551	35762	

	A	E	F	G	H	I	J	K	L	M	N	O	P
167	**Sheep**												
168	MA Ewes												Av weight
169	Average Weight	63.7	63.7	63.7	63.7	65.9	67.4	70.2	72.4	73.9	70.8	804.7	67.1
170	Maintenance (0.6 MJ ME/kg^0.75)	13.5	13.5	13.5	13.5	13.9	14.1	14.6	14.9	15.1	14.6		
171	LWG : at MJ ME/kg LWG:	0.00	0.00	0.00	0.07	0.05	0.10	0.07	0.05	-0.10	-0.10		
172	ME for weight gain	0.0	0.0	0.0	4.6	3.3	6.5	4.6	3.3	-2.8	-2.8		
173	LWG : at MJ ME/kg LW Loss	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
174	ME for pregnancy and Lamb(s)	17.0	19.0	9.0	0.0								
175	TOTAL ME:	30.5	32.5	22.5	18.1	17.1	20.6	23.5	18.1	12.3	11.8		
176	ME for Shearing effect	0.00	0.00	0.00	0.00	0.00	0.00	4.37	0.00	0.00	0.00		
177	kgDM/hd/day:	2.6	2.8	2.3	1.8	1.7	2.1	2.2	1.7	1.1	1.1		
178	Days	30	31	30	31	31	28	31	30	31	30		
179	Monthly Requirements.	916	1008	676	560	531	577	727	544	382	355	7877.2	1.31
180	**Period**	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN		
181	**Season**	Spring	Spring	Summer	Summer	Summer	Summer	Autumn	Autumn	Winter	Winter		
182	MJ ME/kgDM	11.8	11.8	10	10	10	10	10.8	10.8	11.2	11.2		
183	2ths												
184	Average Weight	58.6	60.1	61.7	63.2	64.7	66.3	67.7	69.2	70.7	72.3		
185	Maintenance (0.6 MJ ME/kg^0.75)	12.7	13.0	13.2	13.4	13.7	13.9	14.2	14.4	14.6	14.9		
186	ME for LWG	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3		
187	ME for pregnancy and Lamb(s)	15.0	17.0	9.0	0.0								
188	TOTAL ME:	31.0	33.2	25.5	16.7	16.9	17.2	21.7	17.7	17.9	18.1		
189	Daily weight gain	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05		
190	ME for Shearing effect							4.2					
191	kgDM/hd/day:	0.3	1.2	1.4	1.4	1.2	1.2	1.3	1.3	1.3	1.3		
192	Days	30	31	30	31	31	28	31	30	31	30		
193	Monthly Requirements.	929	1029	764	518	525	481	671	530	554	544		
194	Ewe Hoggets (inlamb)												
195	Average Weight	48.1	49.6	51.2	52.7	54.2	55.8	57.2	58.7	60.2	61.8		
196	Maintenance (0.6 MJ ME/kg^0.75)	11.0	11.2	11.5	11.7	15.6	12.2	12.5	12.7	13.0	13.2		
197	ME for LWG	3	3	3	3	3	3	3	3	3	3		
198	ME for pregnancy and Lamb(s)	5.3	15.0	17.0	16.0	8.0							
199	TOTAL ME:	19.6	29.5	31.7	31.0	26.8	15.5	19.5	16.0	16.2	16.5		
200	Daily weight gain	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1		
201	ME for Shearing effect							3.7					
202	kgDM/hd/day:	0.3	1.2	1.4	1.4	1.2	1.2	1.3	1.3	1.3	1.3		
203	Days	30	31	30	31	31	28	31	30	31	30		
204	Monthly Requirements.	587	913	952	960	832	434	603	479	503	494		

	A	E	F	G	H	I	J	K	L	M	N	O	P
206	Season	Spring	Spring	Summer	Summer	Summer	Summer	Autumn	Autumn	Winter	Winter		
207	MJ ME/kgDM	11.8	11.8	10.0	10.0	10.0	10.0	10.8	10.8	11.2	11.2		
208	Ewe Lambs												
209	Average Weight	0.0	0.0	28.0	30.3	34.9	39.6	43.8	48.4	52.9	56.0		
210	Maintenance (0.75 MJ ME/kg^0.75)	0.0	0.0	7.3	9.7	10.8	11.8	12.8	13.8	14.7	15.4		
211	ME for LWG	0.0	0.0	9.8	9.8	9.8	9.8	9.8	9.8	6.5	6.5		
212	TOTAL ME:	0.0	0.0	17.1	19.4	23.3	21.6	22.5	23.5	21.2	21.9		
213	Daily weight gain	0.0	0.0	0.2	0.15	0.15	0.15	0.15	0.15	0.10	0.10		
214	ME for Shearing effect					2.8							
215	kgDM/hd/day:	0.0	0.0	1.2	1.9	2.3	2.2	2.1	2.2	1.9	2.0		
216	Days	30.0	31.0	15.0	31.0	31.0	28.0	31.0	30.0	31.0	30.0		
217	Monthly Requirements.	0.0	0.0	256	602	723	604	698	705	658	656		
218													
219	Male Lambs												
220	Average Weight	0.0	0.0	0.0	28.0	32.7	37.3	41.5	46.2	50.7	53.8		
221	Maintenance (0.75 MJ ME/kg^0.75)	0.0	0.0	0.0	9.1	10.2	11.3	12.3	13.3	14.2	14.9		
222	ME for LWG	0.0	0.0	0.0	6.0	6.0	6.0	6.0	6.0	4.0	4.0		
223	TOTAL ME:	0.0	0.0	0.0	15.1	19.0	17.3	18.3	19.3	18.2	18.9		
224	Daily weight gain	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.2	0.1	0.1		
225	ME for Shearing effect					2.8							
226	kgDM/hd/day:	0.0	0.0	0.0	1.5	1.9	1.7	1.7	1.8	1.6	1.7		
227	Days	30.0	31.0	30.0	31.0	31.0	28.0	31.0	30.0	31.0	30.0		
228	Monthly Requirements.	0.0	0.0	234.5	469.0	590.4	485.0	566.2	578.4	565.4	566.6		
229	Carcass weight				12.6	13.7	15.3	16.6	18.5	20.3	21.5		
230	Liveweight *				45%	42%	41%	40%	40%	40%	40%		
231	Breeding Rams												
232	Average Weight	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0		
233	Maintenance (0.6 MJ ME/kg^0.75)	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0		
234	ME for LWG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
235	TOTAL ME:	16.0	16.0	16.0	16.0	16.0	20.8	16.0	16.0	16.0	16.0		
236	Daily weight gain	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
237	ME for Shearing effect	0.0	0.0	0.0	0.0	0.0	4.8	0.0	0.0	0.0	0.0		
238	kgDM/hd/day:	1.4	1.4	1.6	1.6	1.6	2.1	1.5	1.5	1.4	1.4		
239	Days	30.0	31.0	30.0	31.0	31.0	28.0	31.0	30.0	31.0	30.0		
240	Monthly Requirements.	481.5	497.5	481.5	497.5	497.5	583.8	497.5	481.5	497.5	481.5		

Appendix 3. Costs and income per stock class.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	**Costs & Income per Stock Class.**															
2	**Costs**	Capital Value	Interest Rate.	% Months on Farm in Year.	Interest Cost.	Animal health	% Deaths	Cost of deaths	Breeding Costs	Cartage	Shearing/ Dagging	**Total Annual Costs of having Animal on Farm.**	S/Us			
3	**Breeding Bulls**	2500	10%	100%	250.00	15	2%	50.00	0	2.4	0	**317.40**	5	63.48		
4	Cows	800	10%	100%	80.00	15	1%	8.00	20	2.4	0	**125.40**	6	20.90		
5	Bulls (R2yr)	650	10%	100%	65.00	10	1%	6.50	0	12	0	**93.50**	5	18.70		
6	Bulls (R1yr)	400	10%	100%	40.00	12	2%	6.00	0	0	0	**58.00**	4	14.50		
7	Steers(R2yr)	700	10%	100%	70.00	15	1%	7.00	0	12	0	**104.00**	5	20.80		
8	Steers(R1yr)	500	10%	100%	50.00	12	1%	5.00	0	0	0	**67.00**	4	16.75		
9	Replacement Heifer (R2yr) Wet	650	10%	100%	65.00	12	6%	39.00	20	0	0	**136.00**	6	22.67		
10	Replacement Heifer (R1yr)Wet	425	10%	100%	42.50	10	1%	4.25	0	0	0	**56.75**	4	14.19		
11	Replacement Heifer (R2yr) Dry	625	10%	100%	62.50	12	1%	6.25	0	0	0	**80.75**	5	16.15		
12	Replacement Heifer (R1yr) Dry	400	10%	100%	40.00	10	1%	4.00	0	0	0	**54.00**	4	13.50		
13	Heifers (dry) R2yr	600	10%	100%	60.00	12	1%	6.00	0	11	0	**89.00**	5	17.80		
14	Heifers (dry) R1yr	400	10%	100%	40.00	10	1%	4.00	0	0	0	**54.00**	4	13.50		
15	Heifers (Spring Calving) R2yr	650	10%	100%	65.00	15	6%	39.00	20	11	0	**150.00**	6	25.00		
16	Heifers (Spring Calving) R1yr	400	10%	100%	40.00	15	2%	6.00	0	0	0	**61.00**	4	15.25		
17	Heifers (Autumn calving) R2yr	650	10%	100%	65.00	15	3%	19.50	5	11	0	**115.50**	6	19.25		
18	Heifers (Autumn calving) R1yr	400	10%	100%	40.00	15	1%	4.00	0	0	0	**59.00**	4	14.75	Average per S/U for cattle	17.58
19	MA ewes	85	10%	100%	8.50	5	5%	3.83	1	0.38	4.9	**23.61**	1.2	19.67		
20	2th Ewes	95	10%	75%	7.13	5	4%	3.80	1	0	4.9	**21.83**	1.2	18.19		
21	Wet Hoggets	75	10%	75%	5.63	5	5%	3.75	1	0	4.7	**20.08**	1	20.08		
22	Dry Hoggets	65	10%	75%	4.88	3	2%	1.30	0	0	4.7	**13.88**	0.7	19.82		
23	Ewe Lambs	60	10%	25%	1.50	3	5%	3.00	0	1	2.4	**10.90**	0.7	15.57		
24	Ram Lambs	63	10%	25%	1.58	3	5%	3.15	0	2	2.4	**12.13**	0.7	17.32	Average per S/U for Sheep	18.44
25	Rams	250	10%	100%	25.00	5	3%	7.50	0	0	10	**47.50**	0.8	59.38		
26																

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
27	**Wool Returns**	Gis Large Hill Sheep and Beef		Central North Island S/B		H.B. & Wai Hill S/B										
28		Returns	Weight	Returns	Weight	Returns	Weight		Total average							
29		2.96	4.80	3.25	5.50	3.09	5.40									
30		2.83	4.82	2.78	5.20	2.75	4.60									
31		2.61	4.90	2.84	5.10	2.68	5.75									
32		2.45	4.74	2.46	5.00	2.39	5.59									
33		2.49	4.86	2.62	5.00	2.58	5.19									
34	Averages Price	2.67		2.79		2.70			**2.72**							
35	Averages Weight		4.82		5.16		5.31		**5.10**							
36																
37																
38																
39	**Comparable Costs and Return** (	Gis Large Hill Sheep and Beef					Central North Island S/B					H.B. & Wai Hill S/B				
40		Hectares	Gross Inc	Per Ha	Net Inc	Per Ha	Hectares	Gross Inc	Per Ha	Net Inc	Per Ha	Hectares	Gross Inc	Per Ha	Net Inc	Per Ha
41	2002-2003	1,548	634,993	410	129,781	84	550	287,592	523	103,367	188	504	392,796	779	114,120	226
42	2003-2004	1,605	780,603	486	223,441	139	550	307,362	559	119,854	218	511	366,430	717	101,630	199
43	2004-2005	1,605	782,819	488	199,442	124	550	321,779	585	130,731	238	526	393,472	748	84,090	160
44	2005-2006	1,681	751,317	447	89,843	53	550	301,776	549	95,726	174	557	365,521	656	42,786	77
45	2006-2007	1,681	794,233	472	116,392	69	550	325,665	592	118,988	216	566	400,105	707	60,666	107
46	Averages	1,624	748,793	461	151,780	94	550	308,835	562	113,733	207	533	383,665	722	80,658	154
47	Net per ha					94					207					154
48	**Total Net Average per Hectare.**	**152**														
49																

Appendix 4. Pasture supply

	A	B	C	D	E	F	G	H	I
23	**East Coast(Manutuke Research Farm) Feed Budget Data Per Hectare.**								
24	Months	Days	Growth	Monthly total	ME	Total ME	Adjusted to 85% utilised		
25									
26	July	31	19	589	10	-5890	-5007		
27	August	31	33	1023	10.8	-11048	-9391		
28	Septembei	30	47	1410	10.8	-15228	-12944		
29	October	31	47	1457	10.8	-15736	-13375		
30	November	30	38	1140	10.2	-11628	-9884		
31	December	31	37	1147	10	-11470	-9750		
32	January	31	29	899	9.8	-8810	-7489		
33	February	28	30	840	9.2	-7728	-6569		
34	March	31	32	992	9.4	-9325	-7926		
35	April	30	29	870	9.8	-8526	-7247		
36	May	31	24	744	9.8	-7291	-6198		
37	June	30	18	540	9.4	-5076	-4315		
38	Totals	365		11651		-117756	-100093	9903	
39	Average		31.9	971	10.00	-9813	-8341		
40	Figures converted to -ves for conversion to farm models								
41	Set Cost per ME.		0.004			-471.025			

Appendix 5. Farm data

	A	B	C	D
1	Set Costs per ha			
2	Farm Size	-400		
3	Perm Wages	55000		
4	Casual	5000		
5	ACC	600		
6	Electricity	5000		
7	Fert	54000		
8	Weed\pest	5000		
9	Fuel	10000		
10	Vehicle costs	10000		
11	R&M	5000		
12	Phone &mail	1500		
13	Accountancy	2500		
14	Legal	500		
15	Admin	1000		
16	Rates	5000		
17	Insurance	4000		
18	Cash farm exp.	164100		
19	Total per ha	-410		
20				